Orbit

Journal of the Radio Amateur Space Program

No. 18

March/April 1984
$2.50 U.S.A./Canada

Published by AMSAT — The Radio Amateur Satellite Corporation

Star Performers!

ICOM's VHF/UHF Pairs for Satellite Communications

Oscar 10...Are you ready? Join the future of amateur satellite communications with ICOM VHF and UHF transceivers. Read why ICOM is ...*Simply the Best* for satellite communications.

IC-271A/471A Twins

This new series of VHF/UHF base stations offers a combination of features and flexibility found in no other transceivers anywhere. For receiving MODE J down-link, the IC-471A features a less than 0.5 microvolt for 10dB quieting SSB receiver plus an optional mast mounted GaAs FET preamplifier with a 15dB gain.

Thirty-two tunable memories keep the IC-471A ready to go on frequency and to monitor the beacon frequencies. A good noise blanker plus all-mode squelch make listening a real pleasure. 10Hz variable speed tuning, which automatically shifts to 100Hz when needed, and a low-noise PLL that locks to 10Hz makes the frequency resolution of the ICOM Twins second to none. For MODE B use, the IC-471A features a 10W SSB transmitter with variable power control.

ICOM's Stackable Portable Twins IC-290H & IC-490A

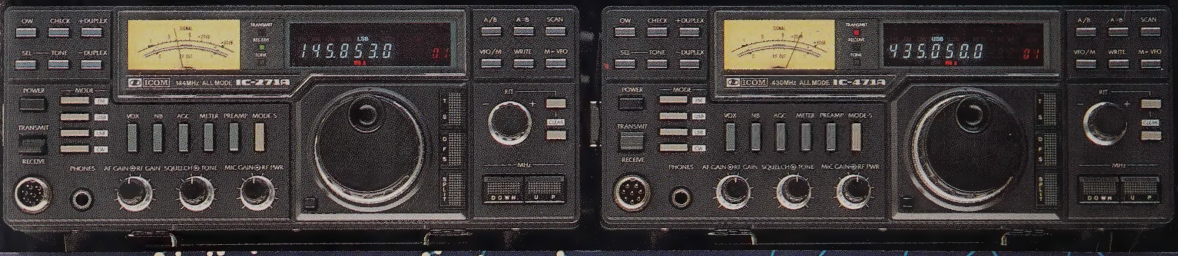
The same basic features of the IC-471A apply to the IC-271A and an optional internal preamplifier with front panel switch is available. The IC-271A transmitter features 25W of transmitter power.

The IC-471A and the IC-271A both have options for computer interfacing. The ICOM BUS is brought out through an optional interface to the back of the radio. From this point, it may be routed to the ICOM computer interface terminal, mounted in a matching box, that will convert the ICOM BUS to RS232C standard. Allowing computer control of both transceiver units, this capability, plus the antenna-tracking programs available for Oscar 10, will make the IC-271A and 471A Twins the ultimate for computer control of your satellite operations.

IC-290H/IC-490A Twins

ICOM's IC-290H and IC-490A mount together as a stackable, mountable pair that offers versatility, portability and satellite capability in an incredibly small size. These units are easily hung from your ham shack bench, taken on portable operations or used mobile.

Each features multiple tuning rates, memories, FM/SSB/CW, programmable scan and priority function, and an all-mode squelch. The IC-290H has a 25W transmitter; the IC-490A, 10W. Both of these transceivers are high quality designs by ICOM and offer all the flexibility needed for satellite operations.



IC-271A VHF Multimode
2 Meter / 25 Watts

IC-471A UHF Multimode
430 — 450 MHz / 10 Watts

ICOM
The World System

ICOM America, Inc., 2112-116th Ave NE, Bellevue, WA 98004 **(206)454-8155** / 3331 Towerwood Drive, Suite 307, Dallas, TX 75234 **(214)620-2780**

All stated specifications are approximate and subject to change without notice or obligation. All ICOM radios significantly exceed FCC regulations limiting spurious emissions.

Orbit

March/April 1984
Volume 5 Number 2

***ORBIT* Staff**
Editor: Harold Winard, KB2M
Contr. Editor/Staff Liaison:
Vern Riportella, WA2LQQ
Assoc. Editor: Dom Mallozzi, N1DM
Managing Editor: Bob Myers, W1XT
Advertising Dir.: Roger Soderman, KW2U
Illustrations: Norma Adamson

AMSAT Board of Directors
John Browning W6SP (Chairman), Tom Clark W3IWI, John Pronko W6XN, Jan King W3GEY, Pat Gowen G3IOR, Harry Yoneda JA1ANG, John Henry VE2VQ

AMSAT Officers
President: Tom Clark, W3IWI
Exec. Vice Pres.: V. Riportella, WA2LQQ
Sr. Vice Pres.: J. Champa, K8OCL
V. P., Engineering Jan King, W3GEY
V. P., Operations: D. Loughmiller, KO5I
V. P. Special Projects: Bill Brown K9LF
Asst. V. P., Eng.: Harold Price, NK6K
Asst. V. P., Eng.: Phil Karn, KA9Q
Asst. V. P., Eng.: S. Robinson, W2FPY
Asst. V. P., Ops. (S/C Ops):
Rick Dittmer, WH6AMX
Asst. V. P., Ops. (User Services):
Ralph Wallio, W0RPK
Treasurer: Jack Colson, W3TMZ
Corporate Secretary: Martha Saragovitz

Headquarters Office Staff
General Manager/Exec. Director:
William Lazzaro, N2CF
Office Manager: Martha Saragovitz

Editorial Office: P.O. Box 575,
Wharton, NJ 07885

Advertising Office: 221 Long Swamp
Road, Wolcott, CT 06716
Phone: 201-666-2870
AMSAT: P.O. Box 27, Wash., DC 20044.
Telephone: 301 589-6062
Telex: 248-566

Second Class postage paid at Waterbury, Conn. by *ORBIT*, 221 Long Swamp Road, Wolcott, Connecticut 06716.

ORBIT (USPS 041-850) is published six times per year for $15. (inseparable from membership dues of $24).

Copyright © 1984 by AMSAT. Contents may be reproduced without specific permission provided proper credit is given, unless otherwise stated and copies are sent both to AMSAT and to the author. Opinion expressed is not necessarily that of AMSAT.

CONTENTS

Technical Features:

5 **JAS-1: Japan's First Amateur Radio Satellite An Innovation Trilogy** PART II
By Shigetake Morimoto, JA1NET; Harry Yoneda, JA1ANG; Haruo Kanawa, JA1JHF; and JAMSAT
The first Amateur Radio Satellite from Japan is described in some detail

7 **A Satellite Builder's Odyssey: January 6 to 18, 1984**
By Harold Price, NK6K
A sophisticated satellite was built in record time. Here's just one of the short stories of dedication which made it all come together.

Informational Topics:

12 **A Survey of OSCAR Station Equipment** PART II
By Harold Winard, KB2M and Roger Soderman, KW2U
Equipment needed to put together an operational satellite communications station is described in detail.

11 **Call for Nominations**

Departments:

3 **Ellipsis...** By Harold Winard, KB2M

21 **AMSAT News**
Minutes of the 1983 Board of Directors Meeting

18 **Worldwide Satellite Activity** By Pat Gowen, G3IOR

17 **W6 Space Philosopher** By John Browning, W6SP

Our Cover: A circularly polarized log periodic antenna covering 125 MHz to 1 GHz as installed at an ITT antenna test range. The six-foot long antenna rides on a 65 foot radius arch. Photo taken from the ground looking skyward. Entire structure including guys is nonmetallic to avoid patten distortions. Range is used to test satellite communication and general purpose UHF antennas. *(Courtesy ITT and WA2LQQ)*

MIRAGE

American made RF Amplifiers and Watt / SWR Meters of exceptional value and performance.

•5 year warranty • prompt U.S. service and assistance

RF AMPLIFIERS

2 METERS-ALL MODE

Model	Specification	Price
B23	2W in = 30W out (useable in: 100 mW-5W)	$89.95
B108	10W in = 80W out (1W = 15W, 2W = 30W) RX preamp	$179.95
B1016	10W in = 160W out (1W = 35W, 2W = 90W) RX preamp	$279.95
B3016	30W in = 160W out (useable in: 15-45W) RX preamp (10W = 100W)	$239.95

220 MHz ALL MODE

Model	Specification	Price
C106	10W in = 60W out (1W=15W, 2W = 30W) RX preamp	$199.95
C1012	10W in = 120W out (2W = 45W, 5W = 90W) RX preamp	$289.95
C22	2W in = 20W out (useable in: 200mW-5W)	$89.95

RC-1 AMPLIFIER REMOTE CONTROL $24.95
Duplicates all switches, 18' cable

WATT / SWR METERS

- peak or average reading
- direct SWR reading

MP-1 (HF) 1.8-30 MHz
MP-2 (VHF) 50-200 MHz
$119.95

430-450 MHz ALL MODE

Model	Specification	Price
D24	2W in = 40W out (1W = 25W)	$199.95
D1010	10W in = 100W out (1W = 25W, 2W = 50W)	$319.95

Available at local dealers throughout the world.

MIRAGE
COMMUNICATIONS EQUIPMENT, INC.

P.O. Box 1393, Gilroy, CA 95020 (408) 847-1857

Ellipsis...

An Editorial by Harold Winard, KB2M

Standards

Perhaps many of us are too close to the action to see it. There's a very important battle going on now within the computer industry. It will have consequences for all of us. Manufacturers, designers, software writers, and users are battling to decide whose computer standard will carry the hearts and pocketbooks of the American public.

Millions are at stake in the computer industry. Advocates on all sides of the issue see the battle as too critical to lose. As the drama unfolds, the hero (or villain, depending on your prejudices) has created a de facto standard in the world of business. IBM has had incredible success in establishing the IBM Personal Computer as the machine of choice for many American businesses. It's starting to become a hot seller overseas as well. Indeed, if an IBM computer is not available, businesses snap up clones, such as the Compaq, Columbia, Corona, or other MS-DOS-compatible machine.

For better or worse, IBM jumped from no share of the market in 1981 to a position of dominance in 1984. By year's end, a PC will be rolling off the assembly line in Boca Raton at the rate of one each seven seconds — all this just three years after the PC was first introduced.

Does this heavy-handed dominance of the computer industry augur well for the computer user? Overall, we think so. Although unanimity on the IBM standard might stifle more creative hardware and software approaches, it does create a solid, sure footing for computer technology. A community that is assured of the long-term integrity of its investment is more apt to invest. What does this have to do with amateur radio and satellites? Our avocation too is seeing exciting times. Silicon chips that fuel the computer revolution also change the way radio amateurs communicate. And it's a very significant change too.

Although cw replaced spark, phone merely supplemented cw. So too has digital communications arrived on our doorstep, not as a replacement for those earlier modes but as a valuable complement. People still enjoy communicating with their voices and that will, we are sure, continue for a long time. And people have also communicated with written language, and amateur facsimile and radio teleprinting have been with us for at least 40 years. But the new kid on the block, still in diapers but growing fast, is a form of digital communications called packet radio. It's a robust child, still wet behind the ears, but full of vigor and promise. It's also a confused child, still groping at its future and uncertain of the direction it will take.

Although reminiscent of radio teletypewriter communications, packet is nevertheless very different and offers a wide range of options for error-free communications, high-speed data transfer, store-and-forward techniques, and computer bulletin-board operation. Where teletype (and it's newest cousin, AMTOR) are mainly used in a people-to-people mode, packet radio finds its real strength in establishing communications between computers. But in amateur radio, just as in the computer industry, standards will play a key role in deciding what the future holds.

In 1982, an AMSAT-sponsored conference resulted in a very important agreement on basic packet radio protocols. That meeting brought us the AX.25 specification for amateur digital packet communication and set the stage for the current boom in interest in the technique. This standarization came just in time, for the newly founded Tucson Amateur Packet Radio (TAPR) group was about to unveil new packet radio equipment into the amateur world — a torrent that has now placed over 1000 sets of hardware in the hands of radio amateurs around the world. But AX.25 defined just two layers of the protocol — the "physical" layer and the "link" layer. The former gives guidelines for the electrical properties of the equipment required for person-to-person packet communicating and the latter specifies the actual commands that link the communicators together in a common, though user-transparent, software bond. The goal of these standards is to establish (by radio) a virtual "wire" connection between individual users.

(Cont. on page 11)

LET'S TALK

OSCAR

AT HENRY RADIO WE'RE DEDICATED TO EVERY ASPECT OF AMATEUR RADIO ...FROM THE EXCITING AND SOPHISTICATED TECHNOLOGY OF TODAY TO HELPING THE YOUNG NOVICE GET HIS FIRST SIGNAL ON THE AIR.

AND OUR OSCAR 8 & 9 ORBITAL DATA SHEETS AREN'T ALL WE HAVE TO OFFER

- "HAM IN SPACE" TEE SHIRTS
- ORBIT MAGAZINE
- L & R POLARIZED ANTENNAS
- QSL CARDS
- AMSAT BADGES
- LINEAR AMPS
- TRANSCEIVERS FOR OSCAR MODES A, B & J
  - ICOM
  - KENWOOD
  - YAESU
- RECEIVING PRE-AMPS
- ORBIT PLOTTERS
- ASTRON POWER SUPPLIES
- AZMUTH & ELEVATION ROTORS
- ORBIT CALENDARS

IN FACT, WE HAVE IT ALL...WE ARE OSCAR SPECIALISTS!

HENRY RADIO leads the way. Let us answer your questions and help you with your needs. Give us a call—at the L.A. store ask for Jack (WA6VGS)

54 YEARS OF SERVICE

Henry Radio

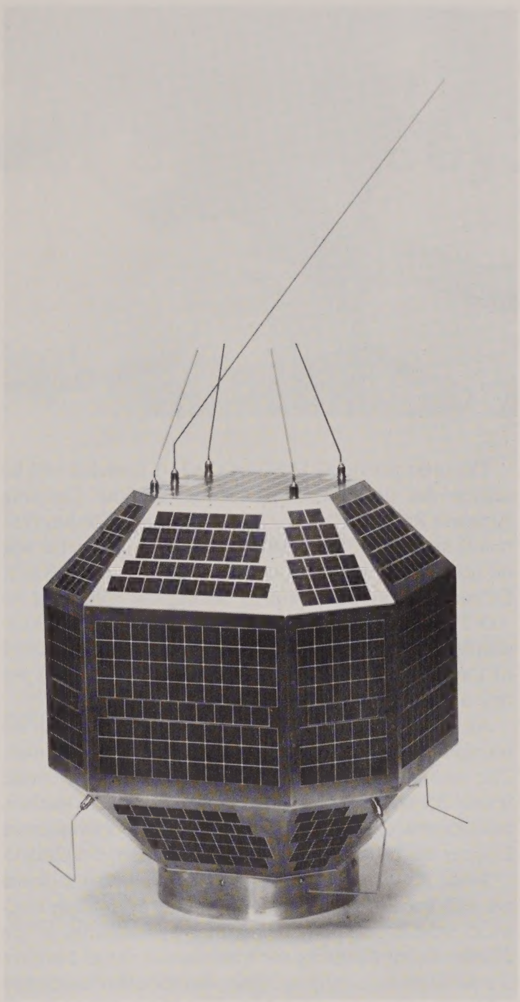
2050 S. Bundy Dr., Los Angeles, CA 90025 (213) 820-1234
931 N. Euclid, Anaheim, CA 92801 (714) 772-9200

TOLL FREE ORDER NUMBER: (800) 421-6631
For all states except California.
Calif. residents please call collect on our regular numbers.

An Innovation Trilogy
Part II

JAS-1: Japan's First Amateur Radio Satellite

By Shigetake Morimoto, JA1NET
Harry Yoneda, JA1ANG
Haruo Kanawa, JA1JHF
JAMSAT

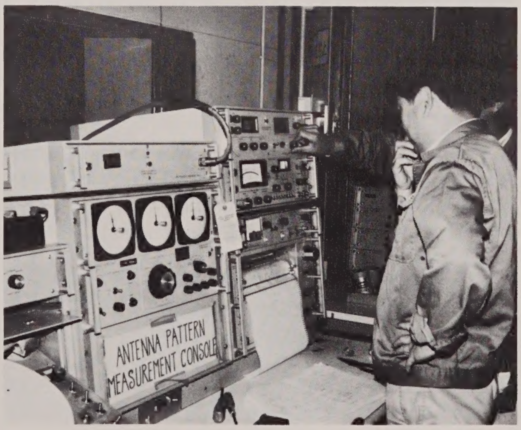


JAS-ONE will be launched from the Tanegashima Space Flight Center in early 1986 aboard NASDA's H-1 two-stage rocket launcher. Japanese Amateur Satellite (JAS)-1 will recall a famous predecessor and simultaneously preview the unfolding world of digital communications. Similar to AMSAT-OSCAR 8, JAS-1 will carry a Mode J linear transponder. However, like PACSAT, JAS-1 will also carry a digital transponder for store-and-forward digital (packet) communications.

The following project overview provides a glimpse of both the systems and schedule we plan.

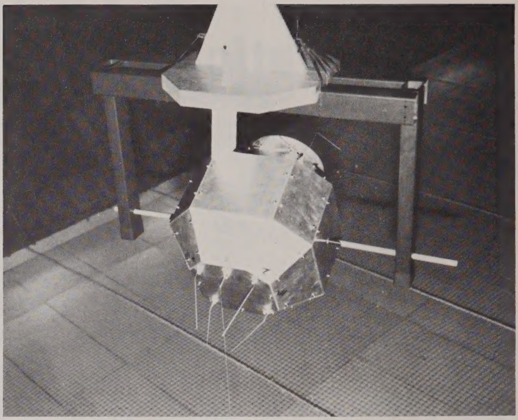
JAS-1 is a joint venture involving NASDA,* JARL** and JAMSAT.*** JAS-1 will provide NASDA an opportunity to carry out a "multi-payload" launch using their new H-1 launcher. NASDA has no experience with multi-payload launches and since JAS-1 will have a telemetry beacon of its own for ranging, this experience can be obtained at very low cost. Amateurs will gain further experience tracking and commanding an amateur satellite not to mention the skills acquired and honed in developing, building and testing the spacecraft itself.

The spacecraft itself will take the form of a 26 faced polyhedron measuring about 40 cm by 40 cm by 50 cm (16" x 16" x 20") and weigh about 50 kg (110 lbs.). The hardware will have a design life (predicted) of at least 3 years.



---

*National Space Development Agency of Japan
**Japan Amateur Radio League ***Japan (AMSAT)



The orbit provided JAS-1 by the H-1 launcher will be unique for an OSCAR (Orbiting Satellite Carrying Amateur Radio). Though circular at about 1500 km (931 miles) as was AMSAT-OSCAR 7, the JAS-1 orbit will be neither sun-synchronous nor polar (as was AO-7). Estimated inclination will be 50 degrees compared to AO-7's 101 degrees. Similar to the current flock of Russian birds (e.g. RS-5), JAS-1 will have an orbital period of 120 minutes. This will provide an average 8 passes per day of about 20 minute duration.

As mentioned above, JAS-1 will carry two separate transponders. One will be a linear, Mode-J transponder. The second will be a digital store-and-forward device mainly for non-real-time communication between stations located in widely separated time zones. A conventional 2 meter fm transmitter will suffice for the rf uplink.

Mode J is the mode of choice for several reasons. Some are well-known; others are more subtle. Man-made electrical noise is becoming increasingly troublesome in the 2 meter band. Listening for weak downlinks at 2 meters is a problem especially in Japan. On the other hand, 435 MHz does not currently suffer the QRM/QRN evident on 2 meters. Moreover, sky noise is lower at 70 cm providing the bonus of a "cooler" backdrop over which to track the signals of JAS-1. Finally, the planners of JAS-1 wish to provide a capable successor to the popular AMSAT-OSCAR 8 Mode J which we helped engineer and for which we provided the Mode J (J for JAMSAT) transponder.

The linear Mode J transponder will have a 100 kHz passband and have a 70 cm output of two watts PEP. Ground Stations will require about 100 watts EIRP. Like Mode B, it will be an inverting transponder, i.e., LSB on the uplink will yield USB on the downlink. A 100 milliwatt beacon will send telemetry in cw and be switchable to PSK when required.

The digital Mode J transponder will have four 145 MHz input channels using PSK/FM modulation for the uplink. Ground stations will require 100 watts EIRP on this transponder too. A single downlink channel at 435 MHz will transmit at 1 watt RMS using PSK. Signaling code will be NRZ-I and the protocol will be the de facto standard amateur radio standard AX.25 which itself is based on the world-wide ISO X.25 recommendation for a High level Data Link Control (HDLC) protocol. We are considering using a terminal node controller (TNC) similar to the TAPR (Tucson Amateur Packet Radio) or VADG (Vancouver Area Digital Group) systems. There will be 1-megabit of on-board memory made up of 256K bit N-MOS and D-RAMs. Error correction techniques will be incorporated to compensate for soft errors. An NSC-800 running at 1.6 MHz will organize data transmission as well as serve as the JAS-1 IHU (Integrated Houskeeping Unit). Any 8 by n bit codes will be transponded, e.g. ASCII.

The telemetry system will compose a 28 channel (or more) frame.

The telecommand system will fully control both transponders.

The milestone chart below shows those key dates in the project leading to a launch of JAS-1 in February, 1986.

```
=======================================================================

                    JAS-1 Project Milestone Schedule

          1984                :               1985               :   1986
-------------------------------------------------------------------------
F  M  A  M  J  J  A  S  O  N  D: J  F  M  A  M  J  J  A  S  O  N  D: J  F  M

---) Detailed Design Complete

---) Engineering Model Complete

   (--------------) Flight Prototype Complete

   (--------------) System Integration Complete

                 (--------------------------) System Tests Complete

                                            (----------------------) Deliver
                                              Flight Hardware to NASDA

                                                                   ()Launch
```

A Satellite Builder's Odyssey:

January 6 to 18, 1984

By Harold Price, NK6K

(Editor's note: Late in 1983, NASA informed satellite researchers at the University of Surrey in Guildford, England that a launch opportunity was available for the second in the UoSAT series of amateur scientific satellites. Due to the need for replacement of an ailing earth resources satellite, the launch date for Landsat 4 was moved up to March 1984. Work commenced at a rapid pace at Surrey to prepare UoSAT-B for its ride into orbit. In perhaps record time, a sophisticated satellite was built. What follows is just a short recitation from a larger story of the dedication, sleepless nights, and sweat that went into the construction of UoSAT-B.)

Now that enough time has passed to put everything in perspective (i.e., I've procrastinated as long as I thought I could), I can report on my whirlwind tour of far away places: Ottawa — the beautiful capital city of Canada, Guildford, England just south of London — home of the University of Surrey, and several stops in between.

Trip Statistics

Total hours: 336
Total hours sleep: 49
Hours spent at Heathrow airport (London): 12
Hours spent at JFK and Laguardia airports (New York City) starting at 3:00 A.M.: 6
Lowest temperature: −25 °F
Highest temperature: +50 °F
Average temperature: −5 °F

Sights Seen

Attic room in Ottawa
Basement workshop in Ottawa
Monastic cubicle (6 by 9 ft.) at the University of Surrey furnished in "Cool Hand Luke" motif with one bed, one chair, one sink, and facilities down the hall.
Satellite laboratory at the University of Surrey

Board in Tucson

The Digital Communications Experiment, or DCE, consists of three boards, 260 by 160 mm, intended to fit in a box 31-mm high. Lyle Johnson designed the CPU board as well as the general memory (GMEM) cards. A group in Ottawa did the memory board, called the RAM UNIT. The CPU and GMEM cards were wire-wrapped

by Chuck Green. Before they could be tested, both Lyle and Chuck got tied up in the real world, so the wire-wrapped boards were sent to Dallas.

Dallas Delights

The wire-wrapped boards were finished and tested by Bill Reed in Dallas. The actual printed-circuit board layout was done by Bill as well as Bob Stricklin, with help from Dave Cheek and Jose Sancho. Late in November, the pc boards were ready to be made. However, with time running out, it was decided that the layouts be sent to Tucson where it was possible to get 24-hour turn-around on complete boards, including drilled holes. I flew to Dallas, stopping off in Tucson to pick up the boards.

Dallas is a town of which I've only seen one room. I stayed at Bob's place where five of us stuffed, debugged, and tested the CPU and GMEM cards in seven 18-hour days. While the rest of the boards were sent to Ottawa, the Dallas crew stuffed me on a plane to Los Angeles with the test boards.

Back in Los Angeles, work continued on integrating a boot load program, written by Hugh Pett in Ottawa, onto the actual DCE. I also worked on a set of diagnostic routines to run in the DCE, driven by software running on a Radio Shack Model 100 lap computer. Incidently, that computer, which is battery powered and totally self-contained, was invaluable since it ran fine in the US, Canada, and England, including the spin vibration measurements. The computer has battery-backed CMOS program space, so cassette or disk storage is not needed.

Meanwhile in Ottawa, work was begun on assembly of a socketed, or non-flight test board set, using the boards, schematics, and jumper lists sent from Dallas. On December 6, the socketed test set was ready to go. I flew to Ottawa with the Model 100 loaded to the gills with test diagnostic software. (In fact, just 412 bytes were left out of 32 kbytes.) I also brought the test boards from Dallas for comparison and backup.

Ottawa Chill

The official alarm clock in the Kayser household (and the object radiating the most heat) is a small furry dog name Sham. Sham walks up to a visitor's bed, checks the distance and windage, backs off 10 ft., runs at full speed toward the bed, and leaps into the air, landing on the visitor's chest. Next, a 2-ft. long tongue unfurls and the visitor is treated to a canine good-morning kiss. The only flaw in this wakeup plan is that Sham then falls asleep on your chest, worn out after his morning exertions. The large increase in available heat soon sends the recently awoken visitor back to sleep.

I was permitted to load wood into the fireplace/stove. I enjoyed this task, as it reminded me of the 75°F temperatures that I left behind in Los Angeles.

The Ottawa crew was ready. The socketed set was done, ready to accept the ICs. The flight boards were mechanically ready, meaning they had been milled to fit the standard UoSAT module box, through-the-board (via) holes wired shut, etc. We activated the socketed DCE in stages, using junk chips. Once the board was working, the flight chips were inserted and the boards were run overnight. Most of the flight chips had been previously tested by the Ottawa crew. That done, construction of the actual flight boards began.

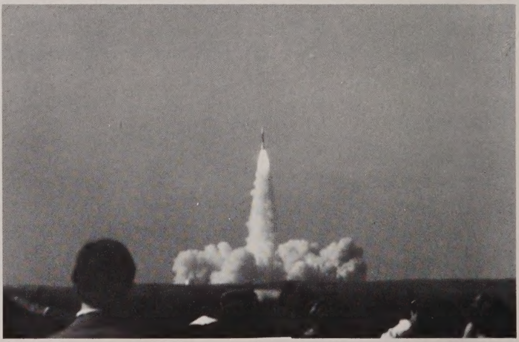
The flight boards were also activated in stages. Since it had only been a short time since the socketed set had been made, and each board has a lot of jumpers, we knew we would probably have to debug the flight boards as well. We also knew that the board component density was such that we needed a multilayer board to make it work. That was especially true since, in the time available, we did not have access to a computer to help us with the board layouts. However, we did not want to use a multilayer board. Instead, we ended up with a double-sided board with a third layer of surface wire and epoxy.

The flight boards worked with little trouble. In fact, the only problem developed when we had to stuff the boards in the flight box in time to get the boards and I to the plane on time. In the hour remaining, we labored to get the boards to fit into the box. In retrospect, all of that was no surprise, since it took two of us 12 hours to get the boards into the box later in Surrey.

Other conditions were also rapidly declining. Everyone had a wife who worked and conditions are such in the Ottawa winter that it is usually feasible to keep only one car running per family. Last Rites had been previously given to the transmission in Larry's car, so we were out of working vehicles. AMSAT Director John Henry, VE2VQ, saved the day by providing transportation to the airport. In addition, John called Air Canada to get permission to carry the flight module, in its 3-ft. by 2-ft. by 9-in. aluminum shipping box, inside the cabin. With 15 minutes to spare, I got on the plane, and Larry, Stan, Gordon, and Hugh breathed a sigh of relief.

Interlude in Toronto

In Toronto, I switched planes for the trip to England. Unfortunately, John's "in cabin" arrangements hadn't carried to Toronto. The "Fragile" sticker I had picked up in Ottawa served to get me past all checkpoints except the last. When I got on the plane, an L-1011, I asked the flight attendant at the door where I could put the



box. He glared up at me from his imposing height of 5 ft. 2 in. (I'm 6 ft. 2 in.) and said "under the plane, of course."

It's funny, how your patience can sometimes expire all at once. I was almost the last person on the plane and I had made up my mind that the only way they would take the DCE away from me was if a policeman larger than me came to get it. I figured that at least in jail I could sleep. Now remember, I was on an L-1011, one of the largest things flying, and it wasn't a question of whether or not there was really room on the plane. The short guy was "in charge" and he didn't like the looks of our box, so off it went.

Because I was standing in the airplane's hatch door, they couldn't close it. That disturbance brought a supervisor. I told my story, explained how arrangements had been made, described what was in the box, and offered suggestions as to where it could be safely located for the flight to London. The supervisor said fine and went to find out what the problem was all about. It turned out that the short guy was, in fact, the "service supervisor" or some such title, and had enough authority on the plane to tell the ground supervisor to stuff it...which he did. The supervisor went off in search of a check ticket to accompany my box on its way to the baggage compartment. At that point, I just leaned back against the hatch close mechanism, closed my eyes, and prepared a siege.

At that point, something happened that pointed a way out of my dilemma. A 6-ft. 7-in. angry Canadian walked up to where I was standing and bellowed, "I was promised seat 18A so I could stretch out my legs. I was given 19E, I want justice, eh?" A surreptitious glance at my boarding pass showed that I had 18A. I interrupted the stream of "Sorry sir, but there's nothing we can do" to tell the short guy that I'd gladly give my seat to the big fellow if supervisor would just put my box in the big empty space behind row 16. Since the supervisor had not yet returned with the baggage check ticket, and we were 15 minutes overdue for departure, he capitulated.

Saturday in Surrey

Due to a mixup, no one was waiting to pick me up at the airport. I had left Canada two days later than I thought I would, and the UK group hadn't received word that I'd finally gotten on a plane. After an interesting time figuring out how to get change for the pay phone (The United Kingdom has more coin denominations than the rest of western civilization put together.), I arrived at Surrey. My first task was to get five hours sleep. Martin had made arrangements to put me in one of the onsite "guest rooms." After I woke up (I don't remember going to bed that day.) I surveyed my room. I guess "functional" would be the best word to describe it. As stated above, it was the sort of room made famous by Cool Hand Luke, Papillon, Escape from Alcatraz, Stalag 17, etc. It was however, close to the lab.

The disk jockey on the local radio station in the town of Surrey is a chap named Damien Dark. Damien's main claim to fame is that he never speaks. That would normally be a fine way to maximize the music time if it weren't for the people calling to express their joy at having a DJ that never speaks. If Damien gets a chance to spin four disks an hour he's doing well.

I was taken to a pub once. It was actually a trip for a visiting group of NASA brass, but after I leaped into the car and started screaming they had to take me along. The pub had been described as a scenic spot but, unfortunately, all the scenery was outside. The only time I ever left the lab was after dark. Sigh.

The other high point was a 10:00-P.M. trip to get "take away" food at Brent's Burgers. I'd be willing to bet that the street outside Brent's was used as a filming location for the movie "A Clockwork Orange." If you haven't seen it nor read the book, a great deal of the motion picture revolves around a group of English lads who whomp on people with blunt objects. The scene was no better inside, as most of Brent's staff and customers had tiny gold earrings in their ears. Those were the men, I was afraid to look at the women.

My next task was to find a local supply of Coca-Cola, my drink of choice. Coke in England, I think, is made by a chap who had once taken a trip to the United States and had seen an ad on TV for Coke, but had never actually tasted any. To make matters worse, Coke at a restaurant is served warm, with a slice of lemon tossed in. It makes a great mixture for cleaning sidewalls or stripping varnish and leaving a "lemony fresh smell," but little else.

The Surrey crew couldn't have been nicer though, or more helpful. I was given more than enough table space, test equipment, and tools. An altogether dedicated crew of bright folks, they were also on a 16+ hour schedule. Indeed, many of them had also taken rooms on campus to cut travel time. Roger, Neville, Ian, and Mac were especially helpful, as was Martin Sweeting. I hid this nice bit in the middle, maybe no one will see it, it could ruin my image.

The DCE flight and pre-flight engineering units were both brought up in short order. The two problems that were isolated during the following three days of intensive testing were fixed in short order. One was a design error masked by a small difference between the junk chips used for initial checkout and the flight chips, the other was a missing jumper.

The DCE was tested with the command-receiver system, using all the data paths that would be used in flight. That turned up a small timing problem in the ground-based software, due to the delays involved in moving data through the multiple UARTs in the uplink receivers and the command unit. After a small patch to the Model 100 software, the testing was declared a complete success. The boards were then potted in a few places and conformally coated.

With 24 hours left before my return trip to the U.S., I started placing the flight boards into the flight module. Twelve hours later, I was still at it. At 2:00 A.M., Mac stopped by my table on his way out to see what I was doing. The basic problem was this: it simply wouldn't fit. Due to problems we won't discuss here (not quite enough time has passed), the bundle of interboard connections was too large to fit in the space allowed. Several hours, holding jigs, vacuum cleaners, covers, shields, burrs, and Kapton tape later, the middle (sigh) board sported an enlarged cutout to allow the wires to pass. It was 5:00 A.M., six hours until I had to leave for the airport. Mac had written off getting to bed. After helping with the major surgery he wanted to see the patient through.

Around 5:30 A.M. it became apparent that the problems were not over. While the boards fit in the x and y plane, z was giving us trouble. Small ferrite beads had been placed on each of 30 or so internal lines coming from the spacecraft interface connectors. The bulk of those beads were just enough to make the top board peek out of the box. The cumulative effect of all the interboard wiring, the surface wiring, the Teflon tubing on the back of the connectors, and the beads could not be overcome. Something had to go, and the beads were the most expendable. Mac and I experimented until we found a way to get the beads (five on each lead) off of the wires without unsoldering all of them, or pinching them. At 9:45 A.M., the boards were finally placed in the box, and nothing came out the top. Success! I put in the screws that held the boards in the box and took some pictures.

I ran the full battery of tests and the DCE functioned perfectly. I screwed the temporary top and bottom covers on the box, ran more tests, and prepared to leave. I powered the system down, cleaned my work area, and fixed the place up. My last task was to leave the DCE running memory tests to continue the burn-in process. Power was applied, the reset switch toggled, the bootload started, and...nothing. Zip, zilch, zero, nought, nada, DOA, belly up, dead, dead, dead.

Since I was already behind schedule, Martin had asked the lab's fastest driver to take me to the airport. That driver was reputed to never go below 120 km/h, even in parking lots, and to strike terror into the hearts of all who saw the approaching streak in their rear-view mirrors. She was truly disappointed when I told her there would be no trip that day.

I took the covers off, and sadly gazed at the coated boards, safe from my probing test equipment, their secret locked within. I placed a scope probe against the side of the module box, the only "test point" I could reach, and sure enough, two superimposed address signals were on the box. To shorten a long story, two of the interboard wires had been pinched in the spacers holding the boards apart. One was probably conducting to the box all along, the insulation on the other just took longer to move away. Had only the first wire been touching the box, the unit would not have failed until it was mated to the spacecraft, since the box would have been floating until then. During the next twenty-four hours, I got five hours sleep, then repaired the wire with Ian's help. Mac was wisely hiding out until he got word that I was gone, since his previous "How's it going?" had netted him 12-hours labor after his regular 18-hour shift.

Later that day I left Surrey as I had arrived, awake for close to 24 hours, with eyes that were sensitive to sunlight. I checked all my baggage, got on the plane, closed my eyes, and went to sleep. I awoke somewhat when the plane started its takeoff roll, but then phased out again. Suddenly, Bang! It felt like we dropped into a 10-ft. hole. Luggage racks broke open, some oxygen masks came down, and someone on the other side of the plane (a 747) said "Smoke!" It seems that one of our engines had exploded (or was "lost" as the pilot said) during the takeoff run shortly before the point of no return.

The next part of the story is mostly a blur. It wasn't easy trying to sleep in the waiting lounge while trying not to miss the announcement of when Pan Am thought we might get off the ground. Eleven hours and a new plane later, we did. I won't go into detail about our 3:00 A.M. arrival at JFK airport New York City, a taxicab ride through a blizzard to Laguardia airport, sleeping on the floor with other refugees of Flight 001, the trip on US Air to Pittsburgh, or the flight on a Rinky-Dink Airlines 12-seater to Morgantown ("Welcome to Rinky-Dink, when we arrive in Morgantown the big hand will be on the 10...").

After a successful meeting and PACSAT talk at West Virginia University I left for Los Angeles, got home, checked to see if I was still married (I was), and slept for the next two days.

Epilogue

The DCE is still running, having survived shake, rattle, and roll up to 20 g. Congratulations to all involved in designing, building, testing, and delivering a flight-ready 3-board computer. The unit contains a 2-MHz CMOS Z80 microprocessor, 126 kbytes of memory including 16 kbytes of 12-bit wide EDAC, two serial ports, and 24 parallel lines. Everything is fully buffered and fits into a 214 by 160 by 31-mm box. Total current draw is less than 120 mA at 5 V. I don't have a complete list of calls of those involved, and some folks weren't even hams, but thanks go to Lyle, Chuck, Bill, Bob, Dave, Jose, Larry, Stan, Hugh, as well as Gordon, the guy who built the great harness simulators in Ottawa. Thanks also to those I've missed plus the whole gang at Surrey as well as all the wives involved in Tucson, Dallas, Ottawa, and in Los Angeles. Meals at odd hours and clearing the Coke bottles away contributed as much to the success of the project as anything else.

Postscript Thoughts

I've kidded everyone about the living accommodations, but the pit style sofa in Larry's attic studio is the most comfortable thing I've slept on this side of a water bed. The Surrey room did its job — maximize the work time available. All sites involved cut down on distractions that would have endangered completion of the job. There's time to socialize after the launch.

As many of you know, Larry Kayser, whose group of VITA volunteers worked on the batteries for UoSAT-B and on the DCE, was severely burned a few weeks before the final construction campaign began. Fortunately, the third-degree burns were limited to his legs, but he has been through a lot of pain and will be for months to come.

His burns added a complication to efforts to communicate with Larry. When he was in a good and receptive mood there was no sense in talking with him. He was doped up then with pain killers and would agree to anything, but remember nothing. When he was in an evil and foul mood, ready to disagree to such statements as "Sun's up!", he was off the pills but in lots of pain. In spite of his travails, Larry struggled to come up with the right mix of pain and chemical pleasure and did a good job. The first day I arrived was the first day he had the bandages off of his legs. For 50 cents he would show you his legs, for 5 dollars he wouldn't.

Call For Nominations

This Fall we will hold elections for three Directors on the AMSAT Board. Those interested in filling these positions may be nominated by a letter of nomination signed by at least 5 current AMSAT members or by a Member Society. All letters of nomination must be received by the office no later than July 31st. Candidates will be expected to supply background and biographical information. Send nominations to: AMSAT, 850 Sligo Ave., #601 Silver Spring, MD 20910.

Editorial (Continued from page 3)

The next challenge facing packet designers is Layer 3, the networking layer. At that level, instructions determine how packeteers connect to each other over long-distance paths — from town-to-town, state-to-state, and country-to-country. The problems of linking just two radio amateurs together are formidable. The task of joining them over trans- and inter-continental distances can be staggering.

The linch pin of any linking system is a common agreement on the basics, such as frequencies, data format, and other intricacies that make one packet radio receiver recognize the data from another. Just how the East Coast of the U.S. will talk with the West Coast, the Midwest, or with Europe is a key element of a packet radio network and without a common understanding on the procedures, communication will not take place.

When agreements are written, codified, published and then actually used by someone they become standards — clear, unambiguous instructions for creating a system that will work the first time with similarly configured systems elsewhere in the world. Many recognize the need to join together under a common banner. Deciding banner color is another story. Reaching a common agreement is not simple. Most have opinions; many are not compatible.

Amateur radio operators are a fortunate lot since those who have taken a lead in developing tomorrow's packet radio systems are often well-schooled in the need for standard practices and procedures. Meetings, such as those held recently in Trenton, New Jersey under the aegis of the ARRL (and well represented by AMSAT), bring differing viewpoints under a common roof and meld expertise into a strong, cohesive plan for the future. Although such conferences are costly, the dollars and energy spent will serve amateur radio well in the future. And AMSAT will continue to help sponsor and organize these meetings to insure that amateur satellite communications are at the forefront of technology.

AMSAT is helping to extend the radio horizon well into space, first with such high-orbit satellites as OSCAR 10 and soon with a dedicated packet satellite, called PACSAT. Gateway stations into the satellites from local area networks will abound in the near future and getting a printed message from W7 to PA0 via the satellites will seem trivial. Standards will play an important part in securing a viable and reliable system and, much as in the computer industry, will bring users together in a common hardware and software bond.

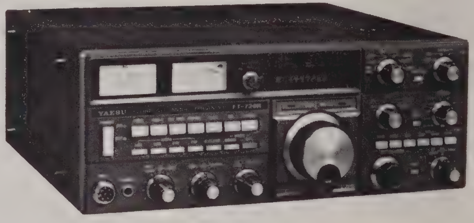
A Survey of OSCAR Station Equipment Part II

By Harold Winard, KB2M, and Roger Soderman, KW2U

The first part of this article appeared in **ORBIT** *issue Number 16. It detailed some of the accessories you can acquire to improve the performance of your OSCAR station. Here is a look at some of the transceivers, converters, and amplifiers that generate, receive, and boost your space-bound signal.*

Although the art of homebrewing is still widely practiced in amateur radio community, many, if not most hams prefer to buy the major pieces of their OSCAR satellite station. Included are such items as transceivers, transmitters, receivers, converters as well as power amplifiers. Most will concede that some homebrew equipment can outperform even the finest piece of factory-built gear. However, the complexity of some pieces of equipment, such as a fully synthesized and microprocessor-driven transceiver, makes construction from scratch a difficult and time-consuming chore.

The economics of the electronics industry require a significant market for a piece of equipment before a manufacturer can commit an assembly line to its construction. Because satellite users still are few in number compared to the rest of the amateur radio community, it is not surprising that few dedicated satellite rigs have been available. The first, set up for use with Mode A (144/28-MHz) transponders, was marketed in the U.S. several years ago by KLM. The second, the FT-726R (Fig. 1) from Yaesu Electronics (Paramount, CA), has proved more successful, reflecting an increased interest in amateur satellite communications, especially since the launch of the first successful Phase III spacecraft — AMSAT-OSCAR 10.



YAESU FT-726R

Figure 1

The FT-726R is a multimode vhf/uhf tribander but comes from the factory equipped only for 144-MHz operation. However, optional plug-in modules for 50 and 432 MHz extend the capability of the rig, as does an i-f unit that gives the transceiver full-duplex and cross-band capability for satellite operation. With that unit installed, tuning and mode selection on each band are independent of each other.

As with most new rigs, the Yaesu transceiver includes such features as i-f shift and width control, provision for a cw filter, memory channels with battery backup, VOX, tone control, and an all-mode squelch. Standard are a built-in ac power supply, selectable agc, continuously variable transmitter power, and a noise blanker. The rig operates from either the ac power line or from a 13.8-V dc supply capable of at least 4.5 A. The power output is 30 W pk-pk on 2-meters and 70-cm. For 6-meter fans, the rig will deliver 20 W pk-pk.

Because most amateur satellites operate in popular bands, much of the equipment designed for terrestrial operation are suitable for use with either Modes A and B. The multimode transceiver, such as the TS-780 from Trio-Kenwood Communications (Compton, CA), gives owners equal access to local contacts, ground-based DXing, or exciting transoceanic satellite contacts on the vhf and uhf bands. The TS-780 operates at 2-meters or 70-cm in either USB, LSB, cw, or FM modes. Memory scanning is useful for keeping track of popular passband net frequencies and can be set up for both bands simultaneously.

Multimode performers from ICOM America (Bellevue, WA) include two base-station transceivers, the IC-271A for 2-meters (Fig. 2) and the IC-471A for operation at 70-cm. Both are nearly identical in appearance and features. For example, the rigs offer 32 full-function memory channels that store both a frequency and mode. And both tune in increments as small as 10 Hz. For the traditionalist, a large front-panel knob tunes the transceiver over its range. For the speedy operator, two pushbuttons change frequencies in 1-MHz steps. Both rigs measure 11-$^{1}/_{4}$ by 4-$^{3}/_{8}$ by 10-$^{3}/_{4}$ in. and operate from ac power or a separate 13.8-V dc supply. The IC-271A generates 10 W pk-pk and the IC-471A produces 10 W pk-pk at 70-cm.

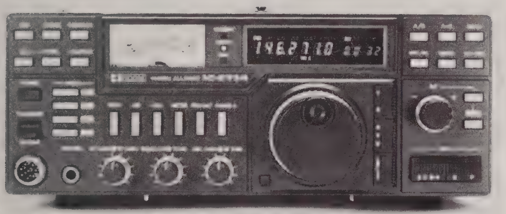


Figure 2

Going Out For a Spin

Mobile rigs are often the answer for hams looking for the best of both worlds: base-station performance and portable convenience. Although they require the addition of a 13.8-V power supply, the transceivers are often so compact that a complete satellite station, plus power supply, can be tucked into one corner of the operating bench or desktop.

Fig. 3 shows the Yaesu FT-290 2-meter multimode transceiver with a matching power supply and 10-W linear amplifier. Basically a portable unit, the rig generates 2.5 W from internal C-sized batteries. Two VFOs allow rapid change from the satellite portion of the band to the FM subband. The frequencies are displayed on an LCD readout. A matching unit, the FT-790R, operates from 430 to 440 MHz. Like the 2-meter model, the 70-cm transceiver runs on internal batteries or an external power supply. Its power output is 1 W.

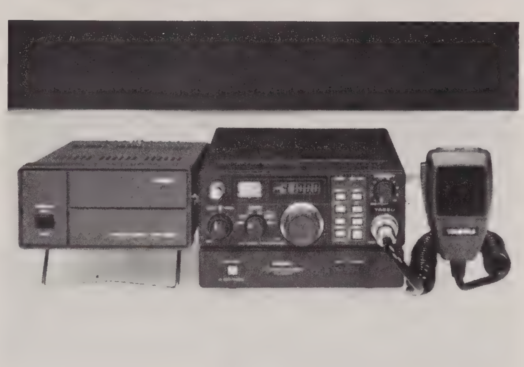


Figure 3

If greater transmitting punch is desired, Yaesu offers larger rigs: the FT-480R for 2-meters and the FT-780R for 70-cm. Both feature bright fluorescent displays, 10-Hz step tuning, and priority-channel selection. A blanker eliminates pulse-type noise, such as that from an ignition system. The FT-480R produces 20 W pk-pk; the FT-780R, 30 W pk-pk. A station console complements the rigs and provides such operating niceties as an LCD clock, fingertip up/down scanning control, and a built-in power supply.

Kenwood too has complementary vhf and uhf mobile rigs: the TR-9130 for 144-MHz and the TR-9500 for 430 MHz. The former delivers 25 W of rf on all modes and tunes in steps of 100 Hz, 1 kHz, 5 kHz, or 10 kHz. Six memories store popular operating frequencies that are retained by a user-supplied 9-V rechargeable battery. The rigs feature a conventional S/RF meter, a helpful aid for accurately pointing an antenna at a distant satellite. A noise blanker and a receiver incremental tuning (RIT) control also make satellite reception easier.

A popular feature of many modern rigs — the sideband squelch control — is also part of the IC-290A mobile 2-meter transceiver (Fig. 4) from ICOM. Five memories, priority-channel scan, two VFOs, and a built-in noise blanker are some of the features of that compact mobile unit. It measures 6-$^{11}/_{16}$ by 2$^{1}/_{2}$ by 8-$^{5}/_{8}$ in. and delivers 10 W pk-pk to the antenna. The IC-290A's 70-cm mate is the IC-490A, which also produces an output of 10 W pk-pk. An optional battery backup system is available for both rigs. Designated the IC-BU-1, it will sustain internal memory settings for up to 10 hours after the 13.8-V dc operating supply is removed.

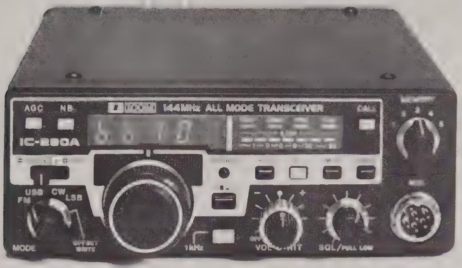


Figure 4

Satellite Station in a Box

Not all hams have vhf and uhf equipment but many have receivers that can tune the 10-meter band. If you're one of those, Ten-Tec (Sevierville, TN) has a fast and easy way for you to enjoy OSCAR-10 quickly. The Model 2510 (Fig. 5) is a complete Phase III station in a box, and requires just a 10-meter receiver. The attractive unit contains a 435-MHz single sideband and cw transmitter plus a 2-meter-to-10-meter receive converter.

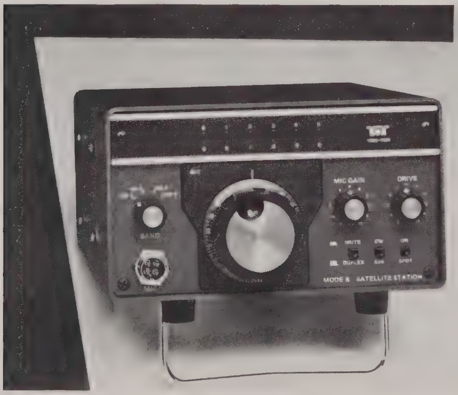


Figure 5

In addition to its small size, other features of the Model 2510 include a typical dynamic range of 85 dB and a 10-W output. Because it is compact, the satellite box makes a welcome traveling companion for the vacationing ham who wants to bring satellite capability to a summer home. With the right antenna, its 10-W output should be sufficient for many satellite contacts.

An external power amplifier can be used to boost station performance if required. Tube types remain popular projects for the homebrewer but solid-state amplifiers hold sway in the commercial market. A favorite of many is the D1010 (Fig. 6) from Mirage Communications Equipment (Morgan Hill, CA). For an input of just 10 W, the D1010 will reward its owner with 100 or more watts of output. A linear amplifier, the unit operates in any mode — FM, ssb, or cw. A built-in and adjustable time delay prevents relay chattering on sideband contacts.

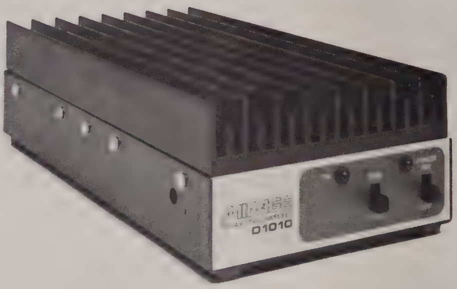


Figure 6

The D1010 draws a hefty 20 A from a 13.8-V dc supply and will accept an input from 430 to 450 MHz with as little as 300 mW to a maximum of 15 W. A smaller amplifier, the D24, operates over the same frequency range and boosts a 2-W input to 40 W of output. For Mode A enthusiasts, Mirage offers a range of 2-meter power amplifiers, including the 80-W output B108, the B1016, a 160-W linear amplifier that requires 30 W of drive. To boost the output of a small exciter, Mirage offers the B23, a 2-W input, 30-W output amplifier.

A new name in amateur radio is TE Systems (Los Angeles, CA). That company's linear rf amplifiers deliver outputs of up to 160 W and can be ordered with a built-in GaAs FET preamplifier. The Model 4410G (Fig. 7) covers 420 to 450 MHz and can produce 100 W for a 10-W input. A built-in GaAs FET preamplifier boasts a 0.8-dB noise figure, 10-dB gain, and a third-order intercept point of +18 dBm. In addition to an array of front-panel switches and LED status indicators, the unit includes a thermostatic switch that shuts the amplifier off if extended transmission at full power produces internal temperatures in excess of +65 °C. Other features include a remote control unit and a one-year warranty on the transistors. TE Systems also manufactures amplifiers for 2 meters. All measure 2.8 by 5.8 by 10.5 in.

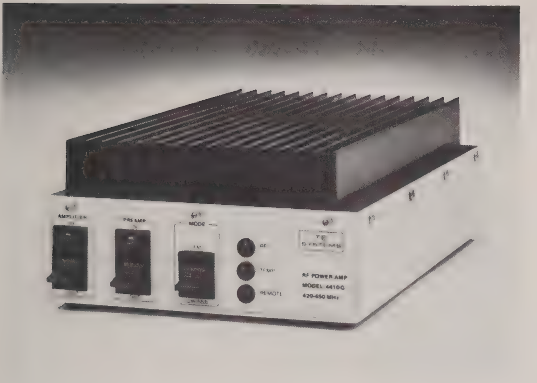


Figure 7

Compact, trim, and with a dash of styling is the HL-45U, a 430-to-450-MHz linear amplifier manufactured by Tokyo Hy-Power Labs and available in the U.S. from Encomm, Inc. (Plano, TX). The booster, shown in Fig. 8, includes front-panel switches to select either FM or sideband operation, to throw a preamplifier on line, and to turn the unit on or off. Status LEDs indicate amplifier operation.

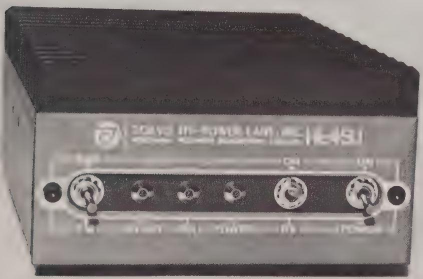


Figure 8

For an input from 2 to 15 W, the HL-45U provides from 10 to 45 W. At the maximum power output, the unit draws 7 A from a 13.8-V dc source. The HL-45U joins an existing line of uhf amplifiers that include the 25-W output HL-20U and the HL-90U, an 80-W amplifier.

Very far removed from Tokyo is Liverpool, the English city that brought us the Beatles and a versatile line of Microwave Modules products, including the MML432 series of linear amplifiers. Models are available to deliver from 30 to 100 W of output. Two of the units have an integral preamplifier. Microwave Modules equipment is offered in North America and elsewhere by distributors, such as Spectrum International (Concord, MA).

Tubes Do the Job

There are some jobs in amateur radio that tubes do very well, for example generating power in the microwave region. A venerable tube, the 2C39, also known as a 7289, is a compact tube with a long history of service in the shack. Angle Linear (Lomita, CA) puts it to work in its Model LCA amplifier, an open-frame style unit designed for those with some technical skill.

Required for operation of the LCA are a separate high-voltage power supply, a tube, a blower, and a meter (all available form the manufacturer). With 1 W of drive, the amplifier will deliver 40 to 50 W of stable output power from 1240 to 1300 MHz. If a more capable exciter is available, the amplifier puts out 250 W, however a water cooling system, such as that supplied by Angle Linear, is a must.

Also using the 7289 tube are the USD 285, a dual-tube 23-cm amplifier, and the USD 200, its single-tube counterpart. Both are manufactured by the Swedish firm Parabolic (Kungsbacka, Sweden) and available in North America from the VHF Shop (Mountaintop, PA). Another European-manufactured unit is the PA 2310 linear power amplifier from SSB Electronic (Iserlohn, West Germany). A transistorized unit, the 2310 turns 500 mW into 10-W output from 1250 to 1300 MHz.

Low-cost Add-ons

Because many hams already have the basic equipment necessary for a satellite station, a careful choice of converters or transverters will have the radio amateur up and running on the birds quickly and with minimum expense. Indeed, it is often possible to select an inexpensive second-hand hf rig, equip it with the necessary converters, and enjoy satellite communications without making a significant dent in the yearly ham radio budget.

For the person who can wield a soldering iron well, the least expensive route is the build-it-yourself converter, such as those from Hamtronics. Those kits come with a choice of input and output combinations, for example the 435-MHz satellite band can be downconverted to 10-, 6-, or 2-meter bands to breathe new life into an unused rig. The same versatility is provided by the 2-meter receiv-

(Cont. on page 16)

ing converter. Both types can be ordered in assembled form.

The kit-builder can also consider receive converters from Lunar Electronics (Fig. 9). Both vhf and uhf models are offered and come with double-sided pc boards, a gold anodized box, and provision for netting the circuit's crystal onto frequency.

The RXXXVDA series of receive converters from Advanced Receiver Research also have provision for crystal netting. The compact units include such other features as an input filter/matching network, a zener diode for temperature stabilization, and low-noise transistors in the rf amplifier stage. The R435VD is specifically designed for reception from 435 to 437 MHz, however the R432/435VD has an additional crystal that allows coverage from 432 to 434 MHz as well. The converters are housed in a rugged aluminum enclosure that lends itself to remote installation.

Microwave Modules also lists receive converters, including two models that translate 70-cm signals to either 10- or 2-m.

But how can you talk through OSCAR-10 with your existing 2-meter rig? Simply connect the rig to a transmit converter that ups the input signal to the satellite band of interest. For example, if you're a Mode L fan, the Microwave Modules MMZ1268/144 may be just the thing. It will connect to a 2-meter exciter and deliver 2 W at the appropriate 1269-MHz uplink frequency for the high-flying elliptical-orbit satellite.

SSB Electronics also produces equipment for the amateur L-band frequency assignment. The UFA-2 is a crystal-controlled oscillator chain that develops 10 mW over a 1-to-1.3-GHz range when driven by an appropriate 2-meter exciter. An amplifier, of course, would be required. The USM-2 is an upconverting transmit mixer that requires 6 mW from an external local oscillator plus from 5 to 200 mW of drive from a 2-meter exciter. With the proper selection of oscillator frequencies, drivers operating on other bands can be used.

Designed expressly for OSCAR-10 use, the XV4 transmit converter from Hamtronics comes equipped with the crystal needed for operation from 435 to 437 MHz. The linear converter, which uses a double-balanced mixer for low spurious performance, comes either as a kit or an assembled unit. As little as 1 mW will drive the unit to 3/4-W output on single sideband or 1 W on cw.

Mindful of the needs of satellite users, as well as those interested in terrestrial microwave communications KLM Electronics (Morgan Hill, CA) has introduced a dual-frequency transverter, that is, a receive and transmit converter in a single enclosure. The Model 1200DF converts the 1269-to-1271-MHz band to 2 meters and generates an output at those microwave frequencies with suitable 144-MHz drive. The output power, 5 W, is suitable for driving a 2C39-type tube amplifier. Similar capability is included for the 1295-to-1297-MHz span.

In addition to the KLM transverter, similar units from other companies can give suitable service in the satellite band as well as in local usage. Transverters from Lunar Electronics and Microwave Modules also can be used for either their receive or transmit functions.

Postscript

Since the first part of this two-part article was written, a new antenna has been introduced to the North American market by the West German comapny Sommer GmbH through its distributor Eurotechnik (Plainville, CT). Designed expressly for the satellite enthusiast, the Type HXP 70-14 helical antenna is just the thing for the Mode B uplink. Standing out from a solid aluminum-alloy reflector are 14 spiral turns that are supported by ultraviolet-resistant polycarbonate-nylon tubes. The boom length is slightly more than 6.5 ft. and the antenna weight just 12 lbs. Windloading is 2.6 ft.^{2}. The antenna's manufacturer claims a gain of 16 dBi and a beamwidth of 38°. The feedpoint impedance is 50 ohms.

Manufacturers Directory

For more information on products mentioned in this two-part article, contact the manufacturer or distributor directly at the address or telephone number shown below. Also check *Orbit* and other amateur radio magazines for information on other manufacturers and on new products designed for the satellite enthusiast. Please mention *Orbit* in your inquiry.

Advanced Receiver Research
P.O. Box 1242
Burlington, CT 06013
(203) 582-9409

(Cont. on page 27)

W6 SPACE PHILOSOPHER

By John Browning, W6SP

Occasional readers of this column may not be aware of my penchant for arranging complex technical and sociological matters into basic categories. A recent example dealt with amateur satellite program participants who were neatly sorted out and summarily tossed into one of three bins containing engineers, operators, or managers, respectively. Simply stated, some of us build satellites, and some of us use satellites, while the remainder attend meetings. Feedback has revealed that not everyone is comfortable with being forced into those concise little slots. I recognize we have many exceptional contributors within our ranks and that some have inclinations and talents that cut across the different categories. Therefore, my apologies to those who don't really fit the molds.

Nevertheless, it can be stimulating to think in terms of controversial categories. For instance, there have been three distinctly identifiable eras of amateur radio. The first included the years from the discovery of wireless to the start of the Second World War. It encompassed a period when it was necessary for most amateur communicators to construct their own transmitters and receivers. To do so, they first had to build many of the essential parts.

We entered a second era following World War II. Discrete electronic components of all kinds became available in abundance. Homebrewing remained in vogue. Hams assembled their own transmitters, which in many cases were superior performance-wise to the more expensive commercial equipment offerings.

We moved into the third era when, about 1970, it became technically and economically advantageous to acquire and use commercial transceivers. That change, of course, coincided with the advent of solid-state electronic miniaturization.

To recap, we have progressed through the Construction Age and the Assembly Age, and are now well established in the Appliance Age. Amateurs from the first two eras seem to have settled comfortably into today's manufactured world. On the other hand, many younger hams find the term "Appliance Operator" offensive. Perhaps our senior members, who cut their teeth in a more primitive environment, perceive they are enjoying the fruits of their earlier struggles. At the same time the clever young ones may harbor an unfulfilled need to face tougher challenges.

The subject came up at a recent amateur radio luncheon held at the Disneyland Hotel in Anaheim, California. The main objective of the meeting was the premiere showing of the American Radio Relay League's "Ham in Space" video tape featuring Owen Garriott, W5LFL. That excellent production was appropriately created by a group of talented hams. Its one flaw is that it doesn't clearly designate Owen's starting era. It may be significant that he used a homebrew antenna.

All three eras were well represented within the receptive audience. One of several from the Construction Age was Walt Henry, W6ZN. While still in his teens, Walt was making his own components at home in Butler, Missouri. In 1927, he and his brother Bob, W0ARA, overcame a personal difficulty by founding Henry Radio. (Brother Ted, W6UOU and sister Mary, W6VWL hadn't yet appeared on the scene.) To build electrolytic rectifiers, Walt and Bob had to purchase quantities of aluminum in excess of their own needs and financial resources. They solved the problem by sharing small amounts of raw material with other hams through ads in *QST*. Walt has adapted well to the successive eras. Today, he is a distinguished AMSAT supporter who has operated with considerable dexterity on the various OSCARs, using assorted domestic and imported appliances.

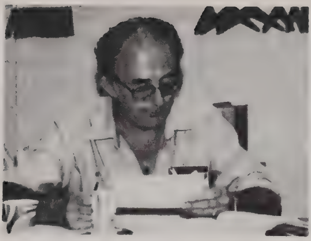
Physical appearance notwithstanding, I qualify as a spokesman for the Assembly rather than the Construction Age. My first station was put together from readily available discrete components, including an oscillator crystal, a vacuum tube rectifier, and a real 807 final. Along with most of my peers, I have for some years resided contentedly in Applianceland.

Several modern era hams attended the Anaheim meeting. Their representation included Harold Price, NK6K. Many of you will recognize Harold as the Program Manager for PACSAT. He spoke very authoritatively of future digital amateur communication satellites. He also articulated impressively in the philosophical arena. Harold seriously believes we are presently in what he calls the Systems Engineering Age. We don't just plug in appliances; we take manufactured subsystems and arrange them into unique, functional, tailored, operating, communications stations. That assertion came as a shock because it conflicts with my own carefully thought out categories. But then, Harold is a bright lad who deserves our attention.

Obviously, some friendly reconciliation of our differing views is needed. Perhaps there are subtle sub-eras of the three main Ages. It is true there were Assemblers who built from kits, others who relied only on handbook schematics, and still others who were clever enough to come up with their own designs. Correspondingly, there may be Appliance types who require assistance in connecting their rigs, others who can do it by themselves, and a third group who can actually think up new ways to combine boxes. The obvious beauty of this expanded view of our modern world is that it re-opens the door for individual technological progress!

In my own case, I have retained the ability to connect cables unassisted but I haven't functioned as a creative ham for many years. This fresh line of thought presents a stimulating challenge! Excuse me while I explore potential improvements to my old 1976-model OSCAR terminal. Who knows...maybe I can qualify to become a bona fide, Appliance Age, Systems Engineer.

Move over, Harold!



G3IOR

Worldwide Satellite Activity

By Pat Gowen,* G3IOR

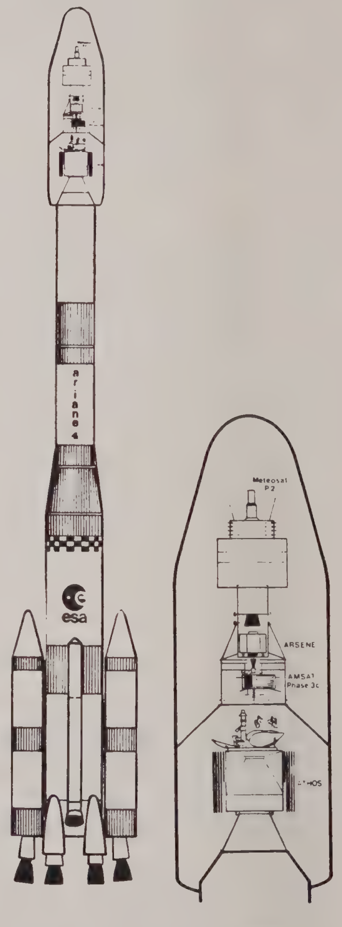
Since our last column was written, we now have 'UoSAT-B' in orbit as UoSAT-OSCAR 11, following a totally successful launch and early initiation. Excellent signals from the 145.825 MHz telemetry beacon were heard at some +8 dB on OSCAR 11 following separation and the University of Surrey "on" command, all readings were nominal. A later command to continue transmission was fully effective, and the new satellite was functioning perfectly as it went out of range, or LOS in Britain. It was still going strong when monitored by Miki, JR1SWB, but was found to be silent when it should have been acquired at AOS by Bud, W6CG. It is not totally clear at this time as to what the problem is, i.e. a command error, a software problem, or a beacon failure. But the most likely cause is thought to be a problem that manifested itself just prior to launch, when the two meter beacon, due to current limitation, went into white noise. The limiter was reset prior to launch, but it seems possible, if not probable, that the drop in temperature as OSCAR 11 went through eclipse re-manifested the condition, which is thus de-sensing the command receiver and not permitting commands to be heard.

Martin Sweeting, G3YJO, at Surrey believes that commands sent on 1.2 GHz might overcome the problem, as it would be unlikely that the wideband noise specturm would extend that far. Accordingly, a command encoder was sent to Chip Angle, N6CA, who will try to access the system. Signals are being heard on 145.825 MHz by those with good front-ends and superior antenna systems and they are likely from the beacon driver stage. VK1DS has the use of a 26-meter dish (29 dBi gain) and is hearing OSCAR 11 at −120 to −135 dBm. Several 2-meter EME stations have reported signals over the noise at TCA.

Plans are now being made with the European Space Agency (ESA) by the Marburg AMSAT group to try for a launch on the Ariane 4 rocket commencing in the 1986-1987 period. Two amateur and two commercial satellites are planned (see diagram). The launch, from Kourou, French Guiana, would place into orbit a new METEOSAT weather satellite, 'ATHOS', a French communications satellite, the AMSAT Phase IIIC satellite, and the French amateur-radio ARSENE satellite.

AMSAT DL are planning for a new Mode 'L' transponder concept, plus a 2.4 GHz (S-band) beacon by DC9RK using a helical antenna. To achieve the 57° inclination desired, some 40 liters of ordinary water will be used as the propellant, as already proposed by Karl Meinzer, DJ4ZC. It surely must be the world's safest fuel prior to electrolytic decomposition and/or heating! More details in a later issue on the plans.

F9QW reports that the AMSAT-F ARSENE project is making steady progress, with over 100 meetings having already been held by the project group under the guidance of F8YY. Until now, no funding has been necessary, since time and materials have been freely donated. But as they approach the launch possibility, it will be imperative to find patrons for financing and sponsors are urgently being sought. If you feel that you can help, please contact F6FHE, or, if you feel that you would like to assist in the actual work, please let F3HK know of your expertise. So far, the UHF receiver and local oscillator are partly completed, with the layout and components complying with the required specification. The 145 MHz rf amplifiers have been virtually completed by the Bordeaux group, while F5EN (Paris) and F3VF (Rennes) continue to make progress on the 2.4 GHz chain. The telemetry transmitter is already complete, and a printed layout will be functioning by September. F2MM has proved the system in its experimental stage to the practical. A complete test of the entire transponder system is imminent. The project group consists of some twenty specialists, of whom half have been in from the start of the operation. Numerous meetings have been held with those in the space industry to do research into the function and availability of components, leading to details of the actual



The Airane IV rocket planned for 1986/1987 launch with the positions of the satellites shown. (1) Meteosat, another weather satellite, (2) ARSENE, the French Amateur Radio Satellite, (3) AMSAT-Phase IIIC, and (4) ATHOS, a French comunications satellite.

Ralf, CE6EZ, working out the next orbit on his TRS-80 computer in his shack.

structure, motor, stabilization system, etc.

To get to the operational side, no signals have been heard from either OSCAR 7 or 8, and the beacons of RS-3 and 4 remain silent. RS-2 (or is it RS-1?) continues to chirp away with his '5's, while RS-5 to 8 are still going strong until the next eclipse period, with the 'ROBOT's' being activated regularly. A new contest activity period is being planned for the 'RS' series in June, and though intended for the USSR, overseas participation will be welcome. UA3CR went to Tiksi Bay with Vassily, UA3DTD earlier this year, to set up EK0DTD, Asia, and Zone 19. Operation was on 145.920 and 145.970 MHz uplink in preparation for a further trip to 4K1 Antarctica destined for January or February 1985.

No news is in hand yet regarding new 'ISKRA' launches from SALYUT-7, but the Cosmonauts can be heard regularly on 142.420-142.430 MHz FM, with their voice link just below our two meter band for those who can tune their receivers that low.

The bulk of activity is on AMSAT-OSCAR 10, with new stations and countries appearing weekly. It is believed that some 92 DXCC countries are now operational on AO-10, and many stations are fast approaching the total possible. Nikki, K5ADQ and Peter, ON7HP, are running neck-and-neck with 83 countries worked each. New and welcome arrivals include OH0AM, GU6EFB/A, W9PW/VP2V, ZD8LM, HB0POM/P, and LZ2US, the latter being the first to arrive of several keen and coming stations in Bulgaria.

With the satellite fast approaching its inclination i.e. the apogee at the 26° North point, "long path" has become possible. OH7AZL has worked several W6's, K5ADQ has worked Victor, UL7DD, both to the West and to the East, and KH6 has been worked both ways from G land. With a little re-angulation by E (or even F layer despite the low sunspot number) it may just be possible to establish antipodeal QSOs. Times and possibilities are being finely studied for the first UK to ZL potential contact.

Werner, PY1BJ, writes from Rio to confirm that to his regret there is very little activity from South America. He believes that a main cause of this is the economic problem caused by escalating inflation and the devaluation of the dollar, which means that very few amateurs can afford to purchase the needed equipment. He has worked out a fine program for satellite tracking in BASCOM on his Radio Shack model III compatible computer. It runs in a quarter of the time that it takes in BASIC.

Ralf, CE6EZ confirms the low activity in South America, as he worked all of the active SA satellite stations in a few weeks! He is delighted to have OSCAR 10 up and active to extend his horizons and opportunity to give many more QSOs. Ralf is trying to furnish a satellite station complete for every radio-club in his country this year. He hopes to stimulate interest and activity and encourage operators to get their own stations active. Also from South America, a good tip comes from Carlos, LU4ENQ,

OSCAR 10 EQUIPMENT

- **Antennas/Accessories**
  KLM 420-450-18C, 143-150-14C, circularity switches, splitters, fiberglass mast/booms
- **Rotors**
  Kenpro KR400, KR500
- **Amplifiers**
  Mirage D1010(N), D24(N), B1016, B3016
- **Preamps**
  Lunar GaAsFET, regular or mast mount, 2m, 70cm
- **Power Supplies**
  Astron 12 Vdc Models from 4A to 50A; metered and nonmetered

★ **New ICOM IC-471A**
all-mode 430-450 rig. Fantastic!

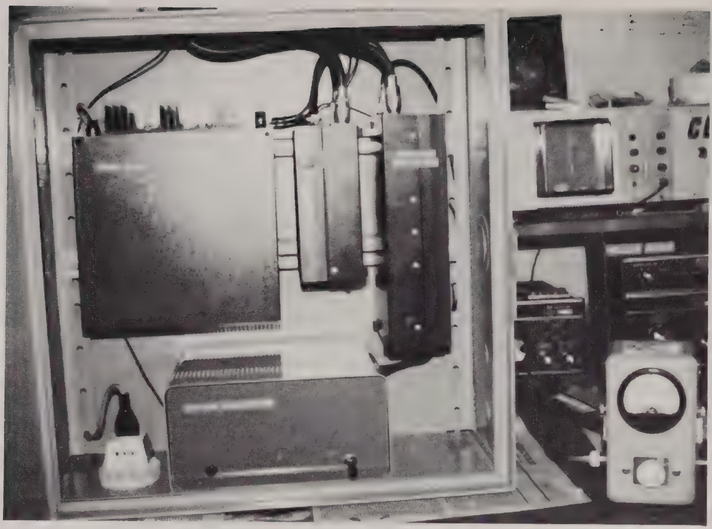
★ **New ICOM IC-271A**
all mode 2-meter rig. Marvelous!

Quality Assured!

KJI Electronics
66 Skytop Road
Cedar Grove, NJ
07009

Call 7-11 P.M.
201-239-4389

VISA/MC ACCEPTED



A watertight housing holds the 70-cm transverter, the Mirage D-101 and B-108 amplifiers and the 30-A power supply in the CE6EZ radio shack.

for TR3000 users. Disconnecting C138 in the agc circuit gives a major improvement when the rig is used for AO-10.

Werner, DJ5KQ, one of the prime sources of our new satellite, has kindly corrected my belief that the first OSCAR 10 QSO was between PA0SSB, Jan, and Karl, DJ4ZC. That was in fact the first QSO after regular operation had begun. The very first QSO on first placing the transponder on was between Karl and Werner, DJ5KQ.

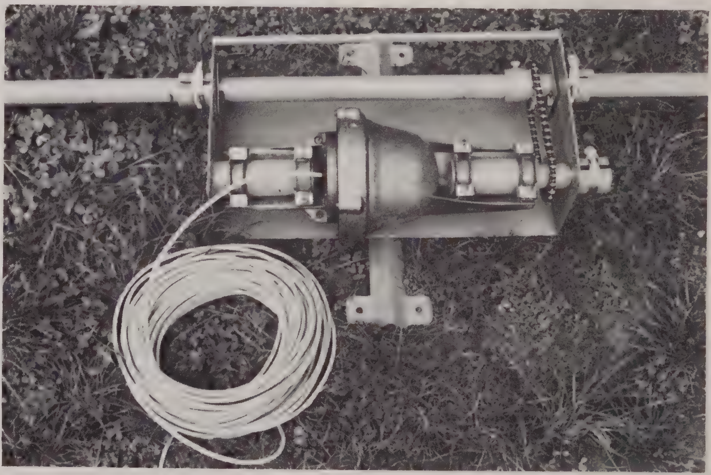
Suggestions have come from numerous sources that an "Alligator of the Month Award" be given to those who outperform all others in pushing the alc in OSCAR 10 to the maximum, and who successfully totally attenuate all other QSOs on the satellite. Anyone stronger than the beacon is eligible on the proviso that the QRO is regular and consistent. Bonus points would be offered to those who have already been told by three or more users to QRP. Any proper user may nominate candidates who qualify. The eventual score for the winner would be calculated from points made up from the number of times told multiplied by the dB over the beacon multiplied by the number of stations that submitted nominations. The overall winner at the end of a year will receive a certificate or replica depicting a large alligator, with a very small brain and a very thick skin. Already we have twelve callsigns on the list, six of them many times over, with prefixes of LX, I, IW, OE, DL, HB, F, FC and W being dominant.

From New Zealand, Murray, ZL3TIB, is active with a 14-element RHCP Yagi to a FET pre-amp with 1.4 dB N.F. ratio then to a R1000 receiver. For transmitting up to 40 W is sent to a 13-element QLY, for QSOs with OH5LK (best DX), P29ZFS, H44PT, ZS6UF, 9M2CR, A71AD, FK0AM, 3D2JS, ZK2RS, VE7XQ, UA0LFK, plus many JA, W, and VK stations. Ross, ZL3ADT, has a 0.6 dB N.F. GaAsFET pre-amp fed from an 8 element vertical Yagi. The transmitter delivers 30 W to an 8/8 skeleton slot-fed beam. He has worked 30 countries to date. His list shows Z25JJ, ZS6US, OH5LK, JY9CF, UL7GBD, UB5MGW, FK1RF, 9M2CR, P29ZFS, H44PT, KL7NO, VE7XQ, WB5LBJ/DU6, UA0LFK, CE3BFZ, YO0AT, VS6HH, LU7FA, YV5ZZ, FR1AC, KG6DX, TI2NA, XE1TU, HL3UJ, with many JA's, W's, and VK's. Ross would very much like to make a sked with LA, SM and OY, since he feels that they could QSO in the short, infrequent window. He would appreciate a line to Ross Johnson, 189 Queensbury Street, Christchurch, New Zealand.

'RS' is still the most popular satellite series in ZL, as most of the time, with the perigee in the Southern Hemisphere, OSCAR 10 is off. But that is expected to change when full-time operation reoccurs and as the satellite goes toward the equator again with its apogee point.

Peter, nee Z25JJ, has moved QTH, leaving Dudley, Z22JW, to represent Zimbabwe on OSCAR 10. He hopes to be on and active again on both AO-10 and EME as soon as he has settled in. The new QTS is W.S. Carey, ZS6CDD, Salbu, P.O. Box 40505, Arcadia 0007, Pretoria, T.V.L., South Africa.

Heinze, DL1CF, is celebrating his 3000th satellite QSO, which includes 55



By his skillful adaptation of an old CDR AR-22 azimuth antenna rotator, CE6EZ has made an effective elevator for his OSCAR-10 system. An old paint bucket filled with sand is used as a counter balance at the antenna itself.

(Cont. on page 31)

AMSAT News

Minutes of the 1983 AMSAT Board of Directors Meeting

Opening

The meeting was convened at 9:38 AM EST on November 18, 1983, at the Columbia Inn, Columbia, Maryland, with the following present: John Browning, W6SP**; John Champa, K8OCL; Tom Clark, W3IWI*; Pat Gowen, G3IOR*; Phil Karn, KA9Q; Jan King, W3GEY*; Bill Lazzaro, N2CF; Doug Loughmiller, KO5I; Bob Myers, W1XT; Harold Price, NK6K; John Pronko, W6XN*; Vern Riportella, WA2LQQ; Martha Saragovitz; Roger Soderman, KW2U; Ray Soifer, W2RS.

Each attendee individually read the previous meeting's minutes and suggested minor correction.

Pat Gowen brought up the issue of AMSAT's apparent involvement with the US military agencies, discussed at the previous board meeting, and agreed to "let sleeping dogs lie."

Commendations

John Browning gave commendations for the previous weekend's Annual General Meeting; a lot of credit is due to the organizers. A discussion followed regarding the format of the meeting and whether parallel presentations should have been held. Pat Gowen expressed frustration at having to miss half the sessions, and suggested that a common Q&A session be added to the meeting. Jan King expressed a need for a more formal opportunity for the members to "respond" to the annual report. Pat Gowan moved the following:

That at the next Annual General Meeting, a two day period should be utilized, if feasible, in which:

1) A non-lecture time slot should be slotted in so that those committed to demonstrations are able to fulfill these obligations and also attend those events of major interest.

2) That a published period of up to two hours should be allotted in the program advertised as a "Q&A" session between the officers and Board of Directors and the membership, giving a needed two-way dialogue and essential feedback on activities and progress, this meeting to be held at the time of anticipated peak attendance.

Jan King seconded this motion, and it was passed 5-0.

The previous minutes were amended to add Martha Saragovitz to the nominating committee listed on page 8, and to mark Roy Rosner, K4YV, as chairman. Pat Gowen moved and Tom Clark seconded a motion to approve the minutes, which was approved 5-0.

Pat Gowen expressed a sentiment that the selection of the AMSAT General Manager was done undemocratically and that the full board of AMSAT directors, e.g. both overseas directors were not involved in the approval process. It was explained that the chairman of the selection committee had not contacted Pat because he had already contacted enough board members to form a majority in favor. A discussion followed on the proper procedure to follow when taking board votes when the board is not in formal session.

The board prepared a comprehensive list of members to be commended for their significant contributions to AMSAT activitis in the past year:

W3OZ and W3XO for their support of the Annual General Meeting; G4GPQ and JR1SWB for their information dissemination activities in Europe and Japan, respectively, during the launch of AMSAT-OSCAR 10; GM4IHJ for tracking software contributions; the entire Phase IIIB design and construction crew: W3GEY, ZS1FE, DJ4ZC, The University of Budapest, W2FPY, W4PUJ, WD4FAB; K4YV for past service as treasurer and chairman of the search/selection committee; the AMSAT-OSCAR 10 telecommand support team: JR1SWB, W0PN, W1HDX, VE1SAT, DJ4ZC, KA9Q, ZL1AOX, W3IWI; the AMSAT Launch Information Network team: WH6AMX, G3AAJ, W0RPK, WA2LQQ; the contributors to and organizers of the AMSAT Software Exchange: N5AHD, N5BF, W0RPK, N0AN, N3AR, K0RZ. Jan King remarked at being very gratified that the whole tracking software area seemed to have "taken on a life of its own."

John Browning moved that AMSAT recognize, by means of certificate and publicity, the outstanding achievements of these members assisting the radio amateur satellite activities. Seconded by John Pronko, passed 5-0.

Internal Communications

Orbit Magazine

Pat Gowen expressed concern that no proof copies of Orbit articles are sent to authors prior to pubication. Others replied that doing so would overburden an already expensive publication process and delay excessively the printing schedule. Tom Clark suggested that editorial review be tightened for policy and technical content. A discussion followed on the proper content of *Orbit*, and how much should be controlled by Board direction, e.g., what the balance should be between technical and introductory articles.

Jan King maintained that *Orbit* is not a vehicle for highly detailed papers from the technical team, and that it could not be used to "sell" industry professionals on AMSAT. Alternative proposals for an outlet for technical reports vis a vis *Orbit* followed. Jan pointed out that AMSAT-DL's 300 *Orbit* subscribers had voted to cancel their subscriptions. Regarding duplication of *ASR* items in *Orbit*, it was felt that certain "must print" articles, followed by lower priority items of lasting importance, should be printed in *Orbit*.

Tom Clark strongly supported the concept of a separate "technical report series", with abstracts to be published in *Orbit*. Each technical author would prepare his/her own material for publication. Jan King proposed, seconded by Pat Gowen, that a committee of Jan King, Tom Clark and Harold Price be formed to create an AMSAT technical publica-

---

*Indicates board member; **indicates chairman. Two board members were not yet present: John Henry, VE2VQ, and Harry Yoneda, JA1ANG. Alternate member Jack Colson, W3OZ, arrived at 2:45 pm. John Henry arrived at 8:47 pm.

tion medium, under the following conditions:

a) Finances are self-sustaining

b) Coordinated with the existing publications staff

c) That is it not parasitic upon *Orbit* Magazine

This motion passed, 5-0.

ASR

Concern was expressed over the growing size of the AMSAT-paid distribution list for *ASR*. Tom Clark moved that the VP Operations be responsible for reviewing the complimentary distribution list for *ASR* with the intent of reducing expenses to the organization. This was seconded by Pat Gowen and passed 5-0.

Telemail

Pat Gowen expressed a concern that Telemail had created an "in" crowd within AMSAT, along with a parochiality towards those not having access. Others strongly disagreed, pointing to the essential role Telemail played at launch time both as an internal pipeline between command stations and as a backbone network for dissemination of information to the members via publications and on-air nets.

A long discussion followed regarding the proper role and cost recovery for Telemail; Tom Clark commented that the "Telemail Experiment" itself had been a great success, but that the fiscal arrangements were not satisfactory. He proposed wider access to Telemail, possibly to include functions now served with N5AHD's bulletin board system, but with automatic charging and usage control. The board voted 4-0, with 1 abstention, to continue use of an electronic mail service (not necessarily Telemail).

Reasons cited included the absolutely vital role Telemail played in the launch and initial operations of OSCAR 10, the manner in which it connects "centers of excellence" within separated AMSAT organizations, and the noticeable improvement in dispersion of information to the general membership. The primary concern was to develop proper financial controls and procedures.

John Pronko moved that a committee consisting of Tom Clark, Phil Karn, Harold Price, Bill Lazzaro and Bob Diersing be formed to examine the electronic mail alternatives, give recommendations to the board, and establish appropriate billing and control procedures. Passed, 5-0.

Pat Gowen suggested the need for intra-user nets, with less one-way broadcasting of information. Problems cited with this approach include propagation on the 15 and 20 meter net frequencies. Pat also moved for institution of additional net(s) on Hf and AMSAT-OSCAR 10 at times selected for optimum propagation and participation to involve membership in 2-way dialogue. This motion was seconded by John Pronko, and passed 3-1 with 1 abstention (John Browning opposed, Tom Clark abstaining).

Financial Report

Bill Lazzaro presented a financial statement and new member reports. The number of members was approximately 4,356, half of which are life members. Trends the months since the launch of AMSAT-OSCAR 10 showed an increase of approximately 3% per month, or 6% per month over "paying" (non-life) members.

Bill reported that sales of tracking software have been very successful as an AMSAT money-maker, with gross sales of $16,000 to date. Many people have been writing in for "freebies", with much interest generated by the upcoming STS-9/W5LFL operation. Opportunities exist for future products. Solutions to the rapid growth in demand were discussed, with the possibility of setting up a separate project group for handling the development and distribution of software.

In the "trinkets" category, AMSAT T-shirts have yet to be profitable while belt buckles have been making money.

Exploratory talks with TRW on an educational program are underway, with the possibility of a $5,000 grant.

Discussion followed on the funding possibilities from aerospace companies for educational programs and their possible impact on the ability of the technical groups to get donations in kind from these same corporations.

Ray Soifer is resigning as Chairman of the Management and Finance Committee. Ray was thanked for his past service to the organization.

The new Satellite Experimenter's Handbook, written by Marty Davidoff, K2UBC, sells for $10.

Bill Lazzaro suggested that university connections be pursued for funding opportunities. The primary advantage is the increased size of each funding award, but a major disadvantage is the overhead taken from each grant by the university. The strong need for volunteers to manage tasks, including fundraising, was expressed. There also appears to be a need for coordination on satellite-related fundraising between AMSAT and VITA, now that they are cooperating on a satellite project.

Just before dinner, a series of possible fundraising ideas (some rather wild, but all plausible) were circulated, including:

a) Salvage rights to defunct OSCARS in orbit and under the oceans

b) Daily sponsorship of satellite operation

c) Daily sponsorship of earth gravity

d) Sales of spacecraft reject parts

Officers

After dinner, the Board discussed the duties of the various officers, particularly the proper roles for the President and the General Manager. Bill Lazzaro, the General Manager, has been acting treasurer since the resignation of Roy Rosner. Changes in the AMSAT bylaws were discussed, but action was deferred to the next day. The results of the recent Board of Directors election were presented. A total of 1,213 votes were cast, 30% of the membership:

Jan King, W3GEY - 1,131 (elected); John Browning, W6SP - 997 (elected); John Pronko, W6XN - 790 (elected); John Henry, VE2VQ - 720 (elected); Jack Colson, W3OZ - 679 (1st alternate); John Montague, W0RUE - 458; Wray Dudley, W8GQW - 370.

A list of suggestions to the Board by Jack Somers, WA6VGS, was discussed. Several of these suggestions regarded the dissemination of financial information, and it was the consensus of the Board that it accommodate these desires while at the same time saving the members' money. The action on each issue was as follows:

1. Require that the bylaws be published every other year for general review by the membership.

Declined; AMSAT Bylaws are already available on request. The estimated cost of publishing the Bylaws in *Orbit* would be $1,000/year.

2. Require a budget or balance sheet be published for review by the membership once a year.

The Board reaffirms its policy that a balance sheet be printed once a year, announced in AMSAT publications, and be made available to the members. This motion was made by Tom Clark, seconded by Jan King, and passed 5-0 with one abstention.

3. Require that platform statements and background reviews be published and accompany ballots mailed to the membership.

Estimated cost would be $600. Declined to take specific action, delegating same to the administrative staff.

4. Require the formation of a "New Projects" Committee who should poll the membership to determine the projects of greatest interest to the members and review new projects and submit recommendations to the Board of Directors.

Delayed until Saturday session.

5. Update Senior Vice-President duties and responsibilities as well as those of the General Manager.

Board declined; no specific action, although the Bylaws were later amended to define the duties of the General Manager.

6. Publish an established organization chart showing the chain of command and responsibilities. Suggest that both the President and General Manager report to the Board of Directors.

No formal action, but the information is to be made available.

7. Appoint a comptroller to approve fund expenditures, etc. (control expenditures).

No formal action.

8. Limit the President to $500 expenditures without Board approval.

No formal action.

9. Require the Board of Directors to review the performance of paid employeees on a quarterly basis.

John Pronko moved that the Board shall conduct a yearly performance review of the General Manager. Seconded by Pat Gowen and passed 6-0.

The first day of the meeting was adjourned at 11 PM.

Day Two

The meeting was reconvened at 9:18 AM Saturday, November 19, with the following present: Ian Ashley, ZL1AOX (arrived 10:45 AM); Bill Brown, K9LF (arrived 11:10 AM); John Browning, W6SP**; John Champa, K8OCL; Tom Clark, W3IWI*; Dick Daniels, W4PUJ; James French, World Space Foundation (arrived 9:49 AM); Pat Gowen, G3IOR*; John Henry, VE2VQ*; Phil Karn, KA9Q; Jan King, W3GEY* (arrived 9:45 AM); Bill Lazzaro, N2CF; Doug Loughmiller, KO5I; Bob Myers, W1XT; Harold Price, NK6K; Terry Price, N6HBB; John Pronko, W6XN*; Vern Riportella, WA2LQQ; Martha Saragovitz; John Shew, N4QQ; Roger Soderman, KW2U; Ray Soifer, W2RS; Bill Tynan, W3XO (arrived 12:23 PM); Harry Yoneda, JA1ANG* (left at 5:30 PM); Rich Zwirko, K1HTV.

The minutes of the previous day were reviewed.

Membership Services

A number of membership and operating award incentives were proposed by Vern Riportella. Ray Soifer described a 3-tier award concept:

a) Operating awards with eye toward controlling the negative aspects of competition.

b) Technical, research, public service and education to be encouraged.

c) Mode L: perhaps recognize more conventional operating awards in order to create Mode L ground hardware.

d) To encourage enlistment of AMSAT membership.

Videotapes, slides, etc., were discussed, as were ways to involve clubs. Computer clubs, especially, are an untapped resource especially with respect to packet radio.

Project Review

Jan King reviewed AMSAT-OSCAR 10. It is generally considered a success. All strategies were proven: a single multitasking computer, software control, active attitude control, and the Mode B transponder. Problems encountered included the wiring error in the kick motor control circuitry, the helium tank leak, and Mode L performance. An uplink on Mode L of +44 dBW (25 kw) EIRP, along with a 16 dBi gain receive antenna and a 1 dB NF preamp are needed to obtain a peak signal-to-noise ratio of 10 dB. The sensitivity problem is suspected to be the failure of a switching regulator in the bias supply of the final amplifier modulator. There is a very strong European interest in Mode L, despite its disappointing performance.

Because of the non-nominal final orbit, a little less power margin will be available with peak sun angles. Various options exist for handling difficult operational conditions that will exist in the future during peak sun angles and eclipse seasons.

On Mode B, the average signal-to-noise ratio seen on voice peaks with a good receiving station is 16 dB.

A need exists for a routine engineering operations plan for AMSAT-OSCAR 10. Alternatives include the "rotating hot seat". There is a need for continued funding to support telecommand activities.

For Phase IIIC, an opportunity may exist for a launch on an Ariane 4 test mission. ESA would accept a "modification to proposal" to include the spacecraft. A marked positive shift in ESA's attitude with respect to AMSAT has taken place in the recent months. The only problems are associated with the real costs and complexity involved in the launch campaign.

The possibility of Karl's earlier proposed "asteroid encounter" mission is small, and he cannot make a dedicated commitment.

User feedback on Phase III must include money if the program is to continue!

Bill Tynan reviewed the status of W5LFL's planned operation on STS-9. Amateurs are credited with discovering an EMI problem in the shuttle ground test equipment during a test of the 2 meter radio. The project is popular with NASA Public Affairs and Headquarters, but unpopular with the science project people.

John Champa introduced Dr. James French from the World Space Foundation, who gave a lunchtime presentation of a proposal for joint development and flight of a solar sail project. After the presentation, Tom Clark introduced a resolution thanking Dr. French for his interesting presentation, saying that we see interesting future possibilities for future cooperation between our two organizations. Seconded by Pat Gowen and passed 6-0.

Harold Price reviewed PACSAT. A $15,000 grant from VITA has been received and spent so far on development and design activities; a design document is available and had been delivered to VITA.

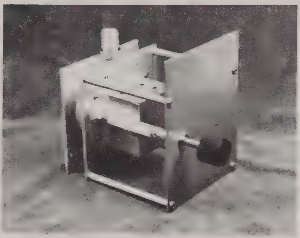
The project is on the same order of complexity as two Phase III satellites, including propulsion, CPUs and attitude control. Target date for launch is 1986; the American and Canadian groups will do the PACSAT experiment proper (8 CPUs), while the University of Surrey constructs the spacecraft frame, IHU and bus. Harold is the full-time PACSAT project manager, with his salary being paid by $30,000 from VITA which also covers some expenses for the engineering development payload on UoSAT-B.

As it is hoped to launch PACSAT from the Space Shuttle, the progress of other small groups also planning on deploying small payloads from a Getaway Special (GAS) cannister was reviewed. Gil Moore of Thiokol Corporation is sponsoring a small FAA radar calibration spaecraft that is planned for deployment from a lidless GAS can on STS-17 in August 1984. Unfortunately, a whole new set of Pandora's boxes are opened with launches on the Shuttle, primarily due to the extremely stringent safety requirements associated with flying on a very expensive manned vehicle.

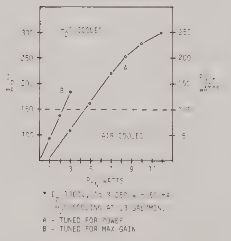
The current project leaders involved with PACSAT are: Harold Price, NK6K, project manager and software manager; Lyle Johnson, WA7GXD, hardware design; Phil Karn, KA9Q, modulation, coding, data modem design; Larry

(Cont. on page 27)

Cavity Power Amplifier 1240 to 1300 MHz



- Single 2C39/7289 tube.
- 50-ohm in & out; no stub tuner req'd.
- 250 watts maximum output.
- Tunes the entire band with front panel control.
- No exposed high voltage while tuning.
- Ptfe (Teflon) anode tuner, no moving metal parts.
- Convenient remote mounting.
- Silver plated 1/8th inch copper plates, heavy aluminum construction for thermal stability.
- Supplied with H_2O cooling and bias switching information.
- Simple hybrid combining for higher output power.
- Over 16,000 hours of continuous operation to date.
- Adjustable output loading control.



- Model LCA without tube $275
  Delivery 14 to 45 days.
- Screw on H_2O jackets for 2C39/7289, anodized aluminum, with gasket . . $17

Other Angle Linear Products:

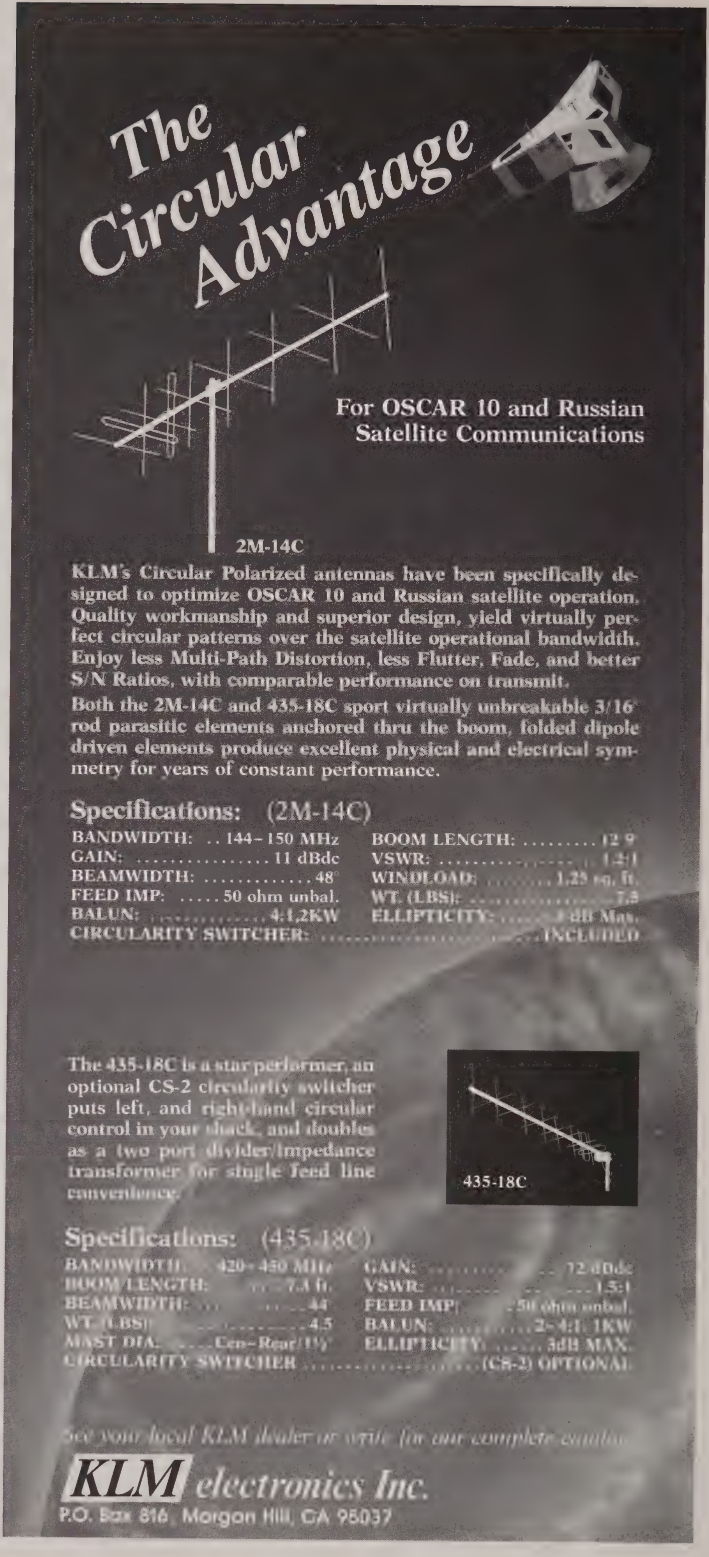
- GaAsFET preamplifiers on any freq. up to 3 GHz. Guaranteed stability.
- Time delay sequence generators for automatic T-R switching, coaxial relay and preamplifier protection.
- Write for data sheets.

Prices and specifications subject to change without notice. Calif. residents add 6½ percent sales tax.

Chip Angle, N6CA (LM 135)

Angle Linear

P. O. Box 35
Lomita, CA 90717


The Circular Advantage
2M-14C
435-18C

For OSCAR 10 and Russian Satellite Communications

KLM's Circular Polarized antennas have been specifically designed to optimize OSCAR 10 and Russian satellite operation. Quality workmanship and superior design, yield virtually perfect circular patterns over the satellite operational bandwidth. Enjoy less Multi-Path Distortion, less Flutter, Fade, and better S/N Ratios, with comparable performance on transmit.

Both the 2M-14C and 435-18C sport virtually unbreakable 3/16" rod parasitic elements anchored thru the boom, folded dipole driven elements produce excellent physical and electrical symmetry for years of constant performance.

Specifications: (2M-14C)

BANDWIDTH: . . 144 – 150 MHz
GAIN: . . . . 11 dBdc
BEAMWIDTH: . . . . 48°
FEED IMP: . . . . . 50 ohm unbal.
BALUN: 4:1,2KW
BOOM LENGTH: . . . . 12'9"
VSWR: 1.2:1
WINDLOAD: . . . . 1.25 sq. ft.
WT. (LBS): 7.8
ELLIPTICITY: . . . . . . 3 dB Max.
CIRCULARITY SWITCHER: . . . . INCLUDED

The 435-18C is a star performer, an optional CS-2 circularity switcher puts left, and right-hand circular control in your shack, and doubles as a two port divider/impedance transformer for single feed line convenience.

Specifications: (435-18C)

BANDWIDTH: . . . 420 – 450 MHz
BOOM LENGTH: . . . . . . 7.3 ft.
BEAMWIDTH: . . . . 44°
WT. (LBS): 4.5
MAST DIA. . . . . Cen–Rear/1½"
GAIN: . . . . 12 dBdc
VSWR: 1.5:1
FEED IMP: . . . . . 50 ohm unbal.
BALUN: 2–4:1, 1KW
ELLIPTICITY: . . . . . . 3dB MAX.
CIRCULARITY SWITCHER . . . . (CS-2) OPTIONAL

See your local KLM dealer or write for our complete catalog

***KLM** electronics Inc.*

P.O. Box 816, Morgan Hill, CA 95037

Orbit Predictions

By KA9Q

```
Satellite: oscar-9
Catalog number: 12888
Epoch time:       84148.40336830
   Sun May 27 09:40:51.21  1984 UTC
Element set:      644
Inclination:        97.5903 deg
RA of node:        122.6521 deg
Eccentricity:     0.0003084
Arg of perigee:    149.0202 deg
Mean anomaly:      211.1146 deg
Mean motion:     15.25760066 rev/day
Decay rate:       5.097e-05 rev/day^2
Epoch rev:            14637
Semi major axis:  6863.607 km
Anom period:      94.379191 min
Apogee:             493.146 km
Perigee:            488.912 km
Beacon:            145.8250 mhz
```

```
Satellite: oscar-10
Catalog number: 14129
Epoch time:       84146.88369060
   Fri May 25 21:12:30.867 1984 UTC
Element set:      103
Inclination:        25.6202 deg
RA of node:        197.5898 deg
Eccentricity:     0.6089713
Arg of perigee:    274.5131 deg
Mean anomaly:       22.7147 deg
Mean motion:      2.05844694 rev/day
Decay rate:        1.21e-06 rev/day^2
Epoch rev:              715
Semi major axis: 26106.549 km
Anom period:     699.556531 min
Apogee:           35630.517 km
Perigee:           3834.239 km
Beacon:            145.8100 mhz
```

```
Satellite: rs-3
Catalog number: 12997
Epoch time:       84146.15537273
   Fri May 25 03:43:44.203 1984 UTC
Element set:      95
Inclination:        82.9606 deg
RA of node:        145.8645 deg
Eccentricity:     0.0060058
Arg of perigee:     36.9567 deg
Mean anomaly:      323.5616 deg
Mean motion:     12.15586627 rev/day
Decay rate:           4e-08 rev/day^2
Epoch rev:            10812
Semi major axis:  7987.332 km
Anom period:     118.461323 min
Apogee:            1664.771 km
Perigee:           1568.830 km
```

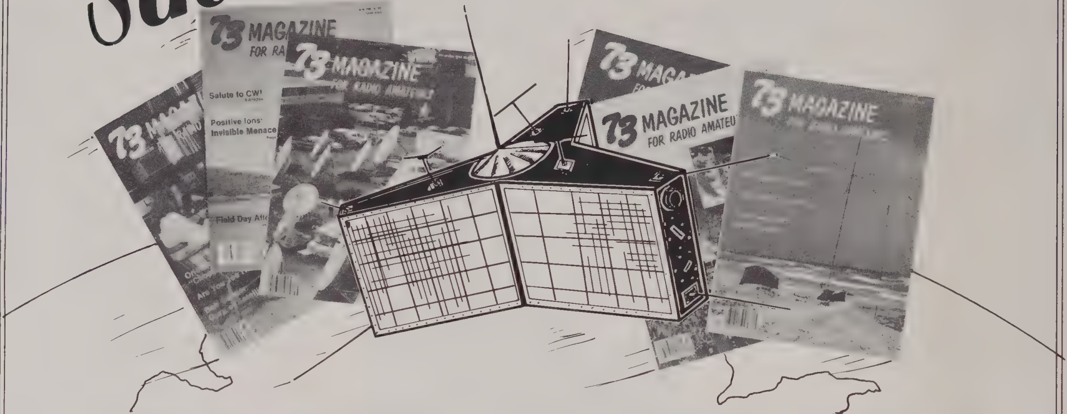
```
Satellite: rs-4
Catalog number: 13000
Epoch time:       84148.16656589
   Sun May 27 03:59:51.292 1984 UTC
Element set:      198
Inclination:        82.9577 deg
RA of node:        153.2989 deg
Eccentricity:     0.0019552
Arg of perigee:    110.8283 deg
Mean anomaly:      249.4829 deg
Mean motion:     12.06666756 rev/day
Decay rate:           4e-08 rev/day^2
Epoch rev:            10755
Semi major axis:  8026.673 km
Anom period:     119.337008 min
Apogee:            1682.622 km
Perigee:           1651.235 km
```

```
Satellite: oscar-11
Catalog number: 14781
Epoch time:       84148.10356205
   Sun May 27 02:29:07.761 1984 UTC
Element set:      29
Inclination:        98.2421 deg
RA of node:        210.3619 deg
Eccentricity:     0.0014072
Arg of perigee:    358.1468 deg
Mean anomaly:        1.9676 deg
Mean motion:     14.61867821 rev/day
Decay rate:        2.58e-06 rev/day^2
Epoch rev:             1262
Semi major axis:  7062.366 km
Anom period:      98.504118 min
Apogee:             694.181 km
Perigee:            674.305 km
Beacon:            145.8250 mhz
```

```
oscar-9:
Wed Jun  6 01:03:01.281 1984 UTC: Ascending node at 137.9 west
Nodal period: 94.43341 min
Longitude increment: 23.606356 deg w/orbit
Element set 644, epoch: Sun May 27 09:40:51.21  1984 UTC

oscar-11:
Wed Jun  6 00:40:39.634 1984 UTC: Ascending node at 44.5 west
Nodal period: 98.56213 min
Longitude increment: 24.639684 deg w/orbit
Element set 29, epoch: Sun May 27 02:29:07.761 1984 UTC

rs-5:
Wed Jun  6 01:56:48.300 1984 UTC: Ascending node at 134.6 west
Nodal period: 119.55415 min
Longitude increment: 30.015553 deg w/orbit
Element set 169, epoch: Sat May 26 02:55:39.224 1984 UTC
```

```
rs-6:
Wed Jun  6 00:39:17.68  1984 UTC: Ascending node at 123.2 west
Nodal period: 118.71513 min
Longitude increment: 29.805589 deg w/orbit
Element set 81, epoch: Wed May 23 10:11:16.361 1984 UTC

rs-7:
Wed Jun  6 00:33:40.787 1984 UTC: Ascending node at 117.2 west
Nodal period: 119.19447 min
Longitude increment: 29.925512 deg w/orbit
Element set 156, epoch: Sat May 19 11:24:26.127 1984 UTC

rs-8:
Wed Jun  6 01:56:24.178 1984 UTC: Ascending node at 132.5 west
Nodal period: 119.76282 min
Longitude increment: 30.067701 deg w/orbit
Element set 274, epoch: Thu May 24 06:32:55.695 1984 UTC
```

Satellites & 73



When it comes to covering satellite communications, *73* runs rings around the competition. *73* publishes more articles about satellites and TVRO than any other ham radio magazine.

- more OSCAR articles
- more LISTENING articles
- more TVRO articles

In fact, since January of 1982, satellite-related articles have averaged 25% of the total number of articles published per issue of *73*. The most recent of those covered such topics as:

- OSCAR Tracking Antennas
- PHASE III
- OSCAR By The Numbers

And our regular monthly feature "SATELLITES" contains the latest AMSAT news, news of the Soviet satellites, OSCAR orbits, and more.

Learn more about satellite communications—subscribe to *73* Magazine and receive 12 monthly issues for only $19.97. Simply complete the coupon below (a photocopy is acceptable) and mail it to:

73 Magazine
P.O. Box 931
Farmingdale NY 11737

☐ ***YES!*** *I want 12 issues of 73 for only $19.97.*

☐ ***Check Enclosed*** ☐ ***Bill Me*** ☐ ***VISA*** ☐ ***MC*** ☐ ***AMEX***

Card# ______________________ Exp. date ____________

Signature______________________ Interbank # ____________

Name ______________________________________

Address ______________________________________

City______________________ State__________ Zip ________

Canada and Mexico—$22.97 1 year US funds only
Foreign surface—$39.97 1 year US funds drawn on US bank only
Foreign Airmail—Please Inquire
Allow 6–8 weeks for delivery.

73 Magazine* ● *PO Box 931* ● *Farmingdale NY* ● *11737 728RBT

Kayser, WA3ZIA/VE3QB, bulk solid state memory; Bill Reed, WB0ETZ, ground station design; Martin Sweeting, G3YJO, spacecraft bus.

The Board moved to commend VITA for their cooperative approach to the PACSAT project and the technical group headed by Harold Price for their technical contributions. Passed 7-0.

Jan next brought up the condition and future of the AMSAT lab at the Goddard Visitors Center, provided for by Goddard at no cost to AMSAT. He asked that someone else's name be placed on the NASA contract due to his impending relocation to Colorado, and asked if there was still a continuing need for the laboratory. Considerable concern was expressed regarding the condition of the lab and the need to keep it in condition suitable for public display. Bill Lazzaro volunteered to take appropriate action with respect to the lab.

John Champa reported on the Independent Space Research Group (ISRG), an organization primarily occupied with an amateur space telescope project. They are looking for an amateur ground tracking network, but are a long way away (several years) from a Letter of Intent, and major problems remain.

Harry Yoneda reported on the status of JAS-1. JAMSAT members did the necessary contacts on behalf of JARL. The JAS-1 concept has been reviewed and an early 1986 launch, the first multi-payload mission for NASDA, is expected.

Changes to AMSAT Bylaws

A series of changes was voted upon. Article V of the Bylaws is amended by deleting Paragraph A thereof, renumbering Paragraphs B through F as Paragraphs C through G and inserting new paragraphs A and B as follows:

"A. A General Manager may be appointed by the Board of Directors at its discretion who shall hold office for a term and upon such compensation as the Board and he may agree. The General Manager shall manage the affairs of AMSAT under the direction of the Board of Directors. He shall serve as an ex officio member of the Board, without vote. He shall authorize and approve all expenditures and shall furnish to the Board of Directors from time to time such statements as may be required. He shall prepare and submit to each meeting of the Board of Directors a comprehensive report of the progress and status of the affairs of AMSAT. He shall perform such other duties as may be assigned to him by the Board of Directors."

"B. The President shall preside over all meetings of the members of the Corporation. He shall, subject to instruction from the Board of Directors, and with the assistance of the General Manager, represent AMSAT in its relationships with the public and the various governments, governmental agencies, and officials with which AMSAT may be concerned and shall be the official spokesman of the Board of Directors in regard to all matters of AMSAT policy. The President may appoint committees for a period of up to one year. Standing Committees shall require the approval of the Board of Directors."

Other Resolutions

"Resolved, that authorized signers on corporate accounts shall be any two of the General Manager, President, Treasurer and Corporate Secretary, and the Corporate Secretary may certify form resolutions to such effect."

Jan King introduced the following motion:

"A separate fund raising effort shall be initiated and conducted by the General Manager in support of the approved satellite projects of the Corporation. Funds so raised shall be set aside for the use of said projects and shall not be available for other uses of the Corporation. The General Manager will establish appropriate acounting procedures for assuring the proper use of these funds, and the Project Manager will have signatory authority."

Pat Gowen moved to approve the proposed 1984 Budget as submitted; John Pronko seconded and the motion was passed 6-0 with Jan King abstaining.

Pat Gowen proposed that the Board meeting be temporarily closed to non-Board members for the election of senior officers; this motion was seconded by Jan King and passed 4-1 with two abstentions.

In closed session, the Board voted to elect the following officers:

President: Tom Clark, W3IWI

Exec. VP: Vern Riportella, WA2LQQ

VP Eng: Jan King, W3GEY

VP Operations: Doug Loughmiller, KO5I

Senior VP: John Champa, K8OCL

VP Special Projects: Bill Brown, K9LF

Corporate Secretary: Martha Saragovitz

Treasurer: Jack Colson, W3OZ

Board Chairman: John Browning, W6SP

Back in open session, the following officers were elected by a vote of 6-0:

Asst. VP Operations, User Services: Ralph Wallio, W0RPK

Asst. VP Operations, Spacecraft ops: Rick Dittmer, WH6AMX

Asst. VP Engineering, Systems: Phil Karn, KA9Q

Asst. VP Engineering/PACSAT Project Mgr: Harold Price, NK6K

Asst. VP Engineering/R&D: Steve Robinson, W2FPY

Thankfully no action was taken to re-elect KA9Q as Secretary to the Board.

Tom Clark and Jan King expressed desired to decrease their personal level of involvement in day-to-day AMSAT activities. Jan will continue to act as a technical mentor and consultant, while Tom will be out of the country on business for long periods and will try to contribute much of his remaining time to technical topics.

Pat Gowen moved to approve the contract between AMSAT and Bill Lazzaro pursuant to which he will serve as General Manager of AMSAT for two years. The General Manager is authorized to commit up to $2,500 on any unbudgeted project and following full consultation with all of the Board of Directors and with the approval of not less than a majority of four, up to $10,000 on any such project. The motion passed 6-0.

Jan King moved to adopt a standing Long Range Planning Committee, consisting of the President, VP Engineering, VP Operations and others as appointed by the President with the objective of creating and maintaining a 5-year operating plan, establishing fund raising goals for supporting technical projects, and identifying resource requirements in order to realize these projects. This motion was seconded by John Henry and was carried 6-0.

The meeting was adjourned at 10:33 PM. — *Phil Karn, KA9Q, Secretary*

Equipment (Cont. from page 16)

Ambit International
200 North Service Road
Brentwood, Essex CM14 4SG
England
(0277) 230909

Angle Linear
P.O. Box 35
Lomita, CA 90717

Cushcraft Corp.
48 Perimeter Road
P.O. Box 4680
Manchester, NH 03108
(603) 627-7877

Eurotechnik
125 West Main St.
P.O. Box 843
Plainville, CT 06062
(203) 747-8068

Hamtronics, Inc.
65 Moul Road
Hilton, NY 14468-9535
(716) 392-9430

Continued on page 28.

High Performance **vhf/uhf preamps**

Receive Only	Freq. Range (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P28VD	28-30	<1.1	15	0	DGFET	$29.95
P50VD	50-54	<1.3	15	0	DGFET	$29.95
P50VDG	50-54	<0.5	24	+12	GaAsFET	$79.95
P144VD	144-148	<1.5	15	0	DGFET	$29.95
P144VDA	144-148	<1.0	15	0	DGFET	$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFET	$79.95
P220VD	220-225	<1.8	15	0	DGFET	$29.95
P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	<1.8	15	−20	Bipolar	$32.95
P432VDA	420-450	<1.1	17	−20	Bipolar	$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	$79.95
Inline (rf switched)						
SP28VD	28-30	<1.2	15	0	DGFET	$59.95
SP50VD	50-54	<1.4	15	0	DGFET	$59.95
SP50VDG	50-54	<0.55	24	+12	GaAsFET	$109.95
SP144VD	144-148	<1.6	15	0	DGFET	$59.95
SP144VDA	144-148	<1.1	15	0	DGFET	$67.95
SP144VDG	144-148	<0.55	24	+12	GaAsFET	$109.95
SP220VD	220-225	<1.9	15	0	DGFET	$59.95
SP220VDA	220-225	<1.3	15	0	DGFET	$67.95
SP220VDG	220-225	<0.55	20	+12	GaAsFET	$109.95
SP432VD	420-450	<1.9	15	−20	Bipolar	$62.95
SP432VDA	420-450	<1.2	17	−20	Bipolar	$79.95
SP432VDG	420-450	<0.55	16	+12	GaAsFET	$109.95

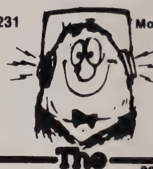
Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include $2 shipping in U.S. and Canada. Connecticut residents add 7-½% sales tax. C.O.D. orders add $2. Air mail to foreign countries add 10%. Order your ARR Rx only or inline preamplifier today and start hearing like never before!

Advanced Receiver Research

Box 1242 • Burlington, CT 06013 • 203 582-9409

812-422-0231

Mon-Fri 9AM-6PM
Sat 9AM-3PM



The HAM SHACK

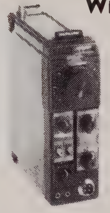
808 N. Main
Evansville, IN 47711

CLOSE-OUT SPECIAL!

ICOM IC-402

- 430 — 435MHz
- Tunable Second Oscillator

For SSB Operation or With Oscar
(Oscar crystals available)



Suggested Retail Price $389

CLOSE-OUT PRICE $249

CALL (812) 422-0231

Equipment (Cont. from page 27)

ICOM America, Inc.
2112 116th Ave. N.E.
Bellevue, WA 98004
(206) 454-8155

KLM Electronics, Inc.
P.O. Box 816
Morgan Hill, CA 95037
(408) 779-7363

Lunar Electronics
2775 Kurtz St.
Suite 11
San Diego, CA 92110
(619) 299-9740

Microwave Modules
Brookfield Dr., Aintree
Liverpool L9 7AN
England
051-523 4011

Mirage Communications Equipment
16890 Church St.
Morgan Hill, CA 95037
(408) 779-7363

Mutek Ltd.
Bradworthy, Holsworthy
Devon EX22 7TU
England
(0409) 24543

Parabolic
P.O. Box 10257
S-43401 Kungsbacka
Sweden

Radiokit
P.O. Box 411
Greenville, NH 03048
(603) 878-1033

Sommer GmbH
Kandelstrasse 35,
D-7809 Denzlingen
West Germany
(07666) 17 04

Spectrum International, Inc.
P.O. Box 1084
Concord, MA 01742

Spectrum West
5717 N.E. 56th St.
Seattle, WA 98105
(206) 523-6167

SSB Electronic
Postfach 199
5860 Iserlohn
West Germany
(02371) 50444

Taniguchi Engineering Traders
2589-1 Shimonagaya-cho
Kohnan-ku, Yokohama 233
Japan

TE Systems
P.O. Box 25845
Los Angeles, CA 90025
(213) 478-0591

Ten-Tec, Inc.
Sevierville, TN 37862
(615) 453-7172

The VHF Shop
Box 349, RD 4
Mountaintop, PA 18707
(717) 868-6565

Inline Relays and Other Ham Accessories

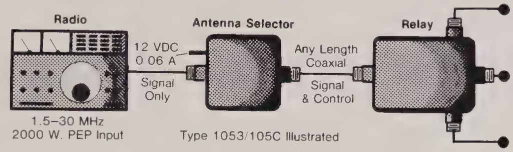
Switch All Your Antennas Over One Coaxial Feedline

With INLINE weatherproof coaxial relays you can add 2, 3, 6, or even 9 antennas without costly control cables. INLINE Relays take the guesswork out of point to point HF communications. By selection, you can instantly compare one antenna to another, switch monobanders, switch from horizontal to vertical, add WARC band antennas, create simple directable wire or vertical arrays, or whatever else you can dream up. On VHF-UHF you can significantly reduce hardline usage, eliminate tower-caused directivity, change polarization, change frequency, or switch antennas.

INLINE relays can be installed virtually anywhere without expensive and unsightly multiwire control cables. They can be placed in the attic, on the roof, on a mast, on a tree, on a tower, anywhere the antennas are.

Some of Our Distinguished Customers

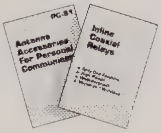
- TRW
- IBM Corp.
- Microlog Corp.
- ITT Mackay
- Eastman Kodak Company



Type 1053/105C Illustrated

Call or Write for Your Free Literature Today

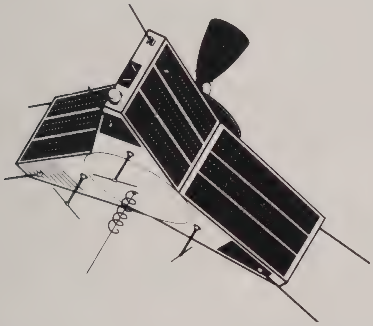
Contact us and we'll send literature on our relays. And, if you like, we can include our complete catalog of ham antenna accessories.



UNADILLA/REYCO/INLINE
A Division of Microwave Filter Co., Inc.
6743 Kinne Street
East Syracuse, NY 13057
Toll Free 1-800-448-1666 TWX 710-541-0493
NY/HI/AK/Canada (collect) 315-437-3953

Trio-Kenwood Communications
1111 West Walnut St.
Compton, CA 90220
(213) 639-9000

Yaesu Electronics Corp.
6851 Walthall Way
P.O. Box 49
Paramount, CA 90723-0049
(213) 633-4007



THE SATELLITE EXPERIMENTER'S HANDBOOK

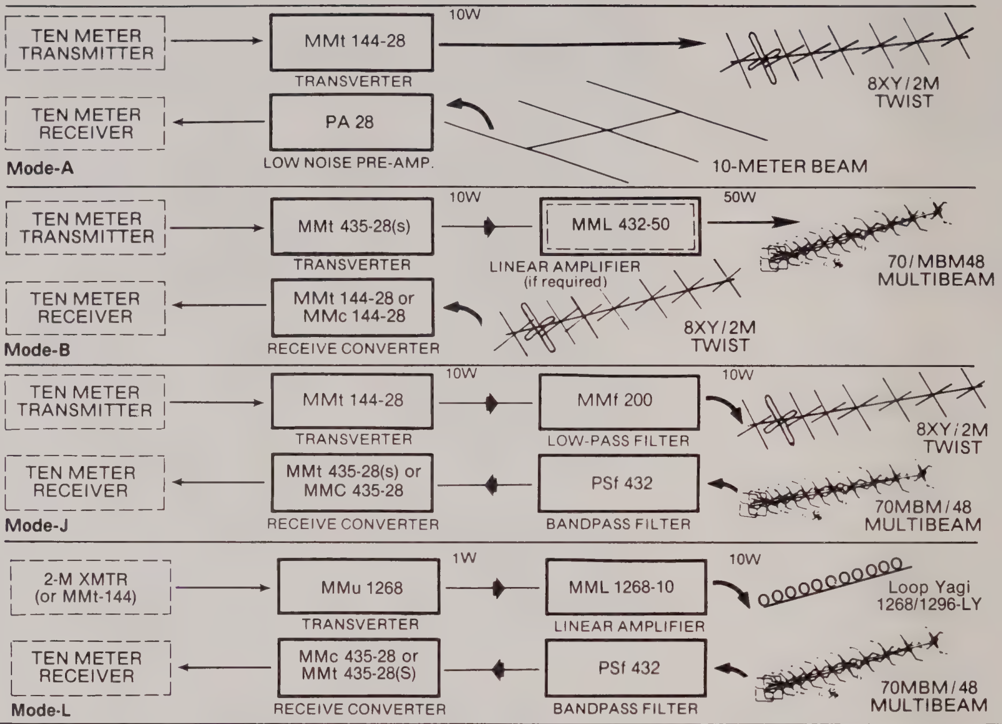
Now, under one cover, here is all you need to communicate through or pick up the signals from orbiting satellites. Whether your interest is in Amateur Radio, weather or TV-broadcast spacecraft, you'll find what you're looking for in *The Satellite Experimenter's Handbook.*

Since the first OSCAR (Orbiting Satellite Carrying Amateur Radio) was launched in 1961, thousands of ham radio operators, scientists, educators and satellite enthusiasts from around the world have used these "birds" for pleasure, education and experimentation. You can join them! And if you're already into satellite communications, you'll find a wealth of practical information on all aspects of these spacecraft—from satellite design to ground-station equipment and antennas.

Whether you're a beginner, an experienced satellite enthusiast, a teacher or a scientist, you'll find *The Satellite Experimenter's Handbook* to be indispensable. $10 U.S., $11 in Canada and elsewhere.

Copies available soon from AMSAT HQ, P. O. Box 27, Washington DC 20044

OSCAR SYSTEMS FROM SPECTRUM INTERNATIONAL



CONVERTERS AND TRANSVERTERS FOR

OSCAR-8
UoSAT/OSCAR-9
OSCAR-10
(Phase III)

Specifications:

Output Power: 10W	Receiver Gain: 30 dB Typ.
Receiver N.F. 3 dB Typ.	Prime Power: 12 Vdc

Receive Converters:		***UHF Filters:***	
MMc 144	$59.95	MMf 200-5	$31.95
MMc 435-28(s)	$69.95	MMf 200-7	$42.95
MMc 435-28(TC)	$69.95	PSf 432	$74.95

Mod. kit to adapt original MMt 432-28 to Mode-J oper: $26.50

AMSAT/OSCAR-10 Mode-L Equipment:
Transverters: 3 Models - selection of 10, 6, 2-meter i-fs.
Transmit only converters: 2 Models - sel. of 10, 6, 2-meter i-fs.
Receive only converters: 3 Models - sel. of 10, 6, 2-meter i-fs.
Antennas: Loop-Yagis, single, twin and quad stacking.
Tx Power Amps (Transistor): 3 Models, ½W/1W input; 8W, 10W, 17W output.

Attention owners of the original MMt 432-28 models: Update your transverter to operate OSCAR-8 and AMSAT/OSCAR-10 (Phase III) by adding 435-to-437 MHz range. Mod. kit including full instructions is $26.50 plus $1.50 shipping.

ANTENNAS

2-Meter 8 + 8 twist Model 8XY/2M	$62.40
Phasing Harness Model PMH/2C	$13.35
48 el. 70 cm Multibeam Model 70-MBM-48	75.75
88 el. 70 cm Multibeam Model 70-MBM-88	$105.50

(All prices FOB Concord, Massachusetts)

Send 40¢ (2 stamps) for full details of KVG crystal filters and other products to fill all of your VHF/UHF equipment needs.

Preselector Filters • Amplifiers • SSB Transverters
Varactor Triplers • Counters • FM Transverters
Antennas • Decade Prescalers • VHF Converters
Oscillator Filters/Crystal Filters • UHF Converters
AMSAT/OSCAR-10 Mode-B and Mode-L equipment

Master Card, VISA accepted.

Transverters by Microwave Modules and other manufacturers can convert your existing low-band rig to operate on the vhf and uhf bands. Models also available for 2m to 70cm and for ATV operations from ch2/ch3 to 70 cm. Each transverter contains both a Tx up-converter and an Rx down-converter. Write for details of the largest selection available.

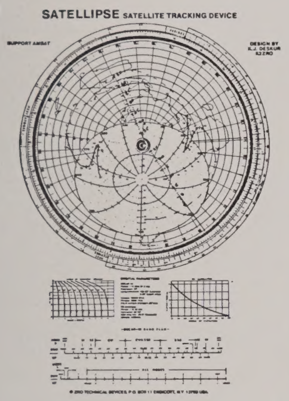
si

Spectrum
International, Inc.
Post Office Box 1084R
Concord, MA 01742 USA

SATELLIPSE

Designed by K2ZRO

OSCAR-10/RS Satellite-Tracking Calculator Kit, as described in *ORBIT* Magazine, but with many additional features.



A "must" for Project OSCAR Orbital Calendar.

Five AZ/EL overlays

Maximum range overlay

Orbital Time and Frequency conversion scales.

Earth-track templates.

Band plan

Graph for converting Latitude of Apogee into Argument of Perigee, and more.

Pre-punched pivoting holes, snap fastener.

$10 in U.S. funds for First Class mail postpaid in U.S. or Canada and Mexico. $14 elsewhere by Airmail.

Send orders or inquiries to ZRO Technical Devices, P. O. Box 11, Endicott, NY 13760.

Worldwide

(Cont. from page 20)

countries on the 'RS' series alone, and 150 QSOs over OSCAR 8 Mode J. He is doing well now on OSCAR 10, when the alligators are absent (list enclosed for the award), and regrets that he is unable to hear the bulletins when they are on. His AO-10 list contains ZS3B, ZR3AL, ZS6UF, ZS6AXT, ZS6BMS, ZS5AAK, FR1AC, EA8CS, EA8AAE, TU2IE (QSL via DL4BAM), TU2GA (QSL via F6CBC), JY7CF, A71AD, 4X4IX, VS6HH, 9M2CR, YB0AQT, HZ1AB (QSL via K8PYD), four KH6's, FK1BG, FK8CR, VK's, 9H1BT, and a whole lot more. Heinz warns those sending to the ARRL for Satellite WAC that he sent the six QSLs plus $4, but received the cards (not the $4) back after six weeks saying that he should apply to his "national WAC Manager"(?). Thus dollars and time might be saved.

Please send your news, views and photos to G3IOR for future issues, but do not expect an early reply if you have complex questions, as some of my mail is over one year behind, and growing.

DESIGN EVOLUTION IN RF P.A.'s

Now with GaAs FET Preamp

- Linear (all mode) RF power amp with automatic T/R switching (adjustable delay)
- Receive preamp option, featuring GaAs FETS (lowest noise figure, better IMD). Device NF typically .5 dB.
- Thermal shutdown protection incorporated
- Remote control available
- Rugged components and construction provide for superior product quality and performance
- Affordably priced offering the best performance per dollar
- Designed to ICAS ratings, meets FCC part 97 regulations
- 1 year transistors warranty
- Add $5 for shipping and handling (Cont. U.S.). Calif. residents add applicable sales tax.
- Specifications/price subject to change

MODEL 1	FREQUENCY 2 (MHz)	OUTPUT POWER (W)	INPUT POWER (W)	SUGG. PRICE LESS TAX $
1410 1410G	144	160	10	225 265
1412 1412G	144	160	30	199 239
2210 2210G	220	130	10	225 265
2212 2212G	220	130	30	199 239
4410 4410G	440	100	10	225 265
4412 4412G	440	100	30	199 239

1. Models with G suffix have GaAs FET preamps. Non-G suffix units have no preamp.
2. Covers full amateur band. Specify 10 MHz Bandwidth for 420-450 MHz Amplifier.

★*SEND FOR FURTHER INFORMATION*★

TE SYSTEMS

TE SYSTEMS
P.O. Box 25845
Los Angeles, CA 90025
(213) 478-0591

LUNAR VHF/UHF Amps w/preamps
Simply, THE BEST

6M10-120 P 6mtr 120w Amp/pa (Export)	CALL!
2M10-80P 2mtr 80 w Amp/pa	175.95
2M2-100P 2mtr 100w Amp/pa	237.50
2M10-150P 2mtr 150w Amp/pa	263.95
2M25-150P 2mtr 150w Amp/pa	246.25
2M10-200P 2mtr 200w Amp/pa	316.75

LUNAR GaAsFET Preamps

PAGxxx 144, 220 or 432 GaAsFET	112.45

LUNAR Low Noise Preamps

PAxx 28, 50, 144 or 220 MHz	31.50
PAIxx as above but RF Switched	43.95
TET Antennas	CALL!

SSB Electronics

PA 1296 10W Linear Amp	CALL!
LST-23 10W 1296 MHz X-verter	CALL!
Microline-13 2304 MHz X-verter	CALL!
Henry Radio VHF/UHF KW's	**CALL!**

LUNAR • MICROWAVE MODULES • UHF UNITS • PARABOLIC • MUTEK • CUE DEE • ICOM • KLM • MIRAGE • F9FT • SANTEC • ASTRON • TOKYO HyPOWER • PUMA • TAMA

MuTek Ltd. NOW AVAILABLE IN US
Low Noise - High Dynamic Range front-end boards with: Low loss relay, RF Amp, DBM, 6 pole Xtal filter, and IF amplifer for:

ICOM IC551 AVAIL. 6/84	CALL!
ICOM IC271 AVAIL. NOW	CALL!
ICOM IC251 & IC211	131.95
Yaesu FT225 & FT221	129.95
SLNA144s RF Switched Preamp, 100w Max input, NF◄1db Gain 15db typ.	74.95
SLNA432s RF Switched Preamp, 100w Max, w/Helical filters NF◄1.4db	134.95
GLBA144e Mast-Mounted GaAsFET preamp, 1Kw PEP Max, includes lin. amplifier sequencer, Interfaces to all rigs!	249.95
MIRAGE D1010N 100w 432 Amp w/N's	275.00
Call for our low Quote on KLM & MIRAGE	
F9FT 1296 23el Yagi	47.35
F9FT 1296 Quad Array + PD + Frame	361.00
F9FT 432 21el Yagi	53.75
F9FT 144 17el Yagi *NEW*	CALL!

PARABOLIC - UHF UNITS - LABE

1296/144 3w Transverter	350.00
1296/144 1w Transverter	291.00
1296/28 1w Transverter	360.00
1269/144 3w Phase III X-verter	350.00
1269/144 1w Phase III X-verter	291.00
1269-1296 Dual tube 120w amp	302.00
1269-1296 Single tube 50w amp	219.00
1296 1 in 3w out amplifier	90.00
1296 1 in 15w out amplifier	359.95
1.2 Meter Dish Kit	89.95
1296 or 2304 Dish feed	70.00
1296 GaAsFET Preamp NF◄.9db	119.00
1269 Circular Dish Feed avail.	July
KENPRO Elevation Rotors	CALL!
CUE DEE 144-15 AN	89.95

Call for your special price on ICOM's IC745, IC751, IC271 Etc.

YAESU FT-726R	CALL!
YAESU FT-980	CALL!

Super Deals ... Call ... Call

MICROWAVE MODULES

MMT144-28 2mtr transverter	199.95
MMT432-28s 432/435 X-verter	279.94
MMT 432-50s as above 50 MHz IF	279.95
MMT1296-144 1.3w X-verter	349.95
MMC144-28 2mtr converter	51.00
MMT432-28s 432/435 conv.	63.00
MMK1296-144 Low noise conv.	123.00
MML432/100 432 MHz 100w amp	379.00

Call on other MICROWAVE MODULE Equip.

**** ASTRON SPECIALS ****

RS7A	47.00	RS35A	127.30
RS12A	65.00	RS35M	147.90
RS12M	83.00	VS35M	165.50
RS20A	84.40	RS50A	194.00
RS20M	10∠.40	RS50M	211.00
VS20M	120.50	VS50M	229.00

YAESU - FACTORY AUTHORIZED DEALER. CALL FOR YOUR SPECIAL PRICE.

PRICES REFLECTED INCLUDE a 2% CASH DISCOUNT.
All prices FOB Mountaintop except were indicated.

WINTER HOURS
M-F 4 p.m.-11:30 p.m.
Weekends Call Anytime!!

THE VHF SHOP
Box 349 RD 4 Mountaintop, Pa. 18707 (717) 868-6565

MC/Visa accepted

Send 2 Stamps for 50+ page Catalog

Your Satellite Headquarters

EEB Electronic Equipment Bank

Special AMSAT Member Sale

YAESU: FT-726 loaded

Full Duplex

List $1357.22

Sale $1019.00

ICOM: IC-271A/H

2-Meter Multimode

271A, 10 watts List $699.00

Sale $649.00

271H, 100 watts **Call**

ICOM: IC-471A

70 cm Multimode

471A, 10 watts List $799.00

Sale $749.00

KLM • KENPRO • BIRD

Order Toll Free
800-368-3270
VA 703-938-3350
516 Mill Street N.E., Vienna, VA 22180
We accept VISA/MC **Sorry no COD**
Tues. Wed. Fri. - 10 A.M. to 5 P.M.
Thur. 10 A.M. to 9 P.M. Sat. 10 A.M. to 4 P.M.
Closed Sunday and Monday
Visit us the next time you are in Washington, DC

Keep OSCAR 10 Flying...

Become an OSCAR-10 Orbit Sponsor!

A special command fund has been established to finance the on-going costs of keeping OSCAR-10 healthy. You can directly contribute to the maintenance of OSCAR-10 by becoming an orbit sponsor.

Just select the day and orbit you'd like to sponsor. Then complete the coupon below and mail it with your donation.

Your contribution will be recognized in two ways. You'll receive a handsome OSCAR-10 ORBIT SPONSOR lapel pin and you'll be listed in *ORBIT* Magazine as a donor.

Won't you help keep OSCAR-10 flying?

Orbit Sponsor Order Form

Name ______________________ *Call* __________

Address ______________________________

City ______________ *State* ________ *Zip* ________

Date of Orbit to be sponsored ______________________

Orbit 1 or Orbit 2 of that day (please circle one)

Donation: ____ *$10 (minimum)* ____ *$25* ____ *$50* ____ *$100*

Enclosed is my ____ *check* ____ *money order* ____ *VISA/MC*

Credit Card Number ______________ *Exp. date* ______

Signature ______________________________

Please send to AMSAT Command Fund, Post Office Box 27, Washington, DC 20044.

YAESU FT-726R TRIBANDER

NEW GALAXIES OF PERFORMANCE ON VHF AND UHF

FULL DUPLEX!!

SATELLITES!!

SCATTER!!

FM!!

EME!!

The New Yaesu FT-726R Tribander is the world's first multiband, multimode Amateur transceiver capable of full duplex operation. Whether you're interested in OSCAR, moonbounce, or terrestrial repeaters, you owe yourself a look at this one-of-a-kind technological wonder!

Multiband Capability

Factory equipped for 2 meter operation, the FT-726R is a three-band unit capable of operation on 10 meters, 6 meters, and/or two segments of the 70 cm band (430-440 or 440-450 MHz), using optional modules. The appropriate repeater shift is automatically programmed for each module. Other bands pending.

Advanced Microprocessor Control

Powered by an 8-bit Central Processing Unit, the ten-channel memory of the FT-726R stores both frequency and mode, with pushbutton transfer capability to either of two VFO registers. The synthesized VFO tunes in 20 Hz steps on SSB/CW, with selectable steps on FM. Scanning of the band or memories is provided.

Full Duplex Option

The optional SU-726 module provides a second, parallel IF strip, thereby allowing full duplex crossband satellite work. Either the transmit or receive frequency may be varied during transmission, for quick zero-beat on another station or for tracking Doppler shift.

High Performance Features

Borrowing heavily from Yaesu's HF transceiver experience, the FT-726R comes equipped with a speech processor, variable receiver bandwidth, IF shift, all-mode squelch, receiver audio tone control, and an IF noise blanker. When the optional XF-455MC CW filter is installed, CW Wide/Narrow selection is provided. Convenient rear panel connections allow quick interface to your station audio, linear amplifier, and control lines.

Leading the way into the space age of Ham communications, Yaesu's FT-726R is the first VHF/UHF base station built around modern-day requirements. If you're tired of piecing together converters, transmitter strips, and relays, ask your Authorized Yaesu Dealer for a demonstration of the exciting new FT-726R, the rig that will expand your DX horizons!

Price And Specifications Subject To
Change Without Notice Or Obligation

YAESU
The radio.

483

YAESU ELECTRONICS CORPORATION 6851 Walthall Way, Paramount, CA 90723 • (213) 633-4007
YAESU CINCINNATI SERVICE CENTER 9070 Gold Park Drive, Hamilton, OH 45011 • (513) 874-3100

TR-9130

All mode (FM/SSB/CW) 25 watts, plus...!!!

The TR-9130 is a powerful, yet compact, 25 watt FM/USB/LSB/CW transceiver. Available with a 16-key autopatch UP/DOWN microphone (MC-46), or a basic UP/DOWN microphone.

TR-9130 FEATURES:

- 25 Watts RF output on all modes, (FM/SSB/CW).
- FM/USB/LSB/CW all mode. Selectable tuning steps of 100-Hz, 1-kHz, 5-kHz, 10-kHz.
- Six memories. On FM, memories 1-5 for simplex or ±600 kHz offset, using OFFSET switch, Memory 6 for non-standard offset. All six memories may be simplex, any mode.
- Memory scan.
- Internal battery memory back-up, using 9 V Ni-Cd battery, (not KENWOOD supplied). Memories are retained approx. 24 hours, adequate for the typical move from base to mobile. External back-up terminal on the rear.
- Automatic band scan.
- Dual digital VFO's.
- Transmit frequency tuning for OSCAR operations.
- Squelch circuit for FM/SSB/CW.
- Repeater reverse switch.
- Tone switch.
- CW semi break-in; sidetone.
- Compact size and lightweight.
- Covers 143.9 to 148.9999 MHz.
- High performance noise blanker.
- HI/LOW power switch. 25 or 5 watts on FM or CW.
- RF gain control. • RIT circuit.

Optional accessories:

- KPS-7A AC power supply.
- PS-20 AC power supply (TR-9500 only).
- BO-9A system base with memory back-up supply.
- SP-120 external speaker.
- TK-1 AC adapter for memory back-up.

TR-9500

70 CM SSB/CW/FM transceiver

- Covers 430-440 MHz, in steps of 100-Hz, 1-kHz, 5-kHz, 25-kHz or 1-MHz.
- CW-FM Hi–10 W, Low–1 W. SSB 10 W.
- Automatic band/memory scan. Search of selected 10-kHz segments on SSB/CW.
- 6 memory channels.

TS-780

All mode "Dual-Bander" ...2-m & 70-cm all mode, dual digital VFO's, 10 memories, scan, IF shift...

TS-780 FEATURES:

- USB, LSB, CW, FM all mode, covering the 2-m band (144.000-148.000 MHz) and the middle 70-cm band (430.000-440.000 MHz). UP/DOWN band switch.
- Dual digital VFO's with normal/tight drag switch. VFO steps in 20-Hz, 200-Hz, 5-kHz, or 12.5-kHz, plus "FM CH" channelized tuning. Split (cross) frequency operation possible. F. LOCK switch provided.
- 10 memories include band and frequency data, backed up by internal batteries (not supplied). Battery life exceeds one year. Memories 9 and 10 for priority instant recall.
- Band scan, with selectable 0.5, 1, 3, 5, and 10-MHz scan bandwidth.
- Memory scan selectable for all memories, or 2-m or 70-cm only.
- IF shift circuit rejects adjacent interference.
- High sensitivity and wide dynamic range.
- 7-digit fluorescent tube digital display.
- 10 watt RF output.
- 2-m ±600-kHz TX offset switch with reverse switch.
- Tone switch for optional TU-4C programmable two-frequency CTCSS encoder unit.
- VOX and semi break-in CW built-in.
- FM center-tune meter.
- Noise blanker for SSB, CW.

TS-780 accessories:

- **TU-4C** programmable two-frequency CTCSS encoder.
- **MC-42S** 500 Ω UP/DOWN hand microphone.
- **MC-48** 16-button Autopatch UP/DOWN microphone.
- **MC-60A** deluxe desk top microphone.
- **MC-80** desk top UP/DOWN microphone.
- **TK-1** AC adaptor for memory back-up.

KENWOOD

TRIO-KENWOOD COMMUNICATIONS
1111 West Walnut, Compton, California 90220